ENERGY USE
AND
GREENHOUSE GAS EMISSIONS
IN
LOS ALAMOS COUNTY:
2000 - 2023

R. B. Gibson

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Executive Summary

Greenhouse gasses emitted into the atmosphere are inducing major changes in our climate. For its part, Los Alamos began pursuing “independence from hydrocarbon energy sources” nearly two decades ago. The specific supporting goals so far established are “to be a carbon neutral electric utility provider by 2040” and “support elimination of natural gas usage by 2070.” To provide a quantitative basis for other specific goals and a baseline against which to measure progress, primary energy use and greenhouse gas emission data are summarized in this report for 2000-2023.

The citizens of Los Alamos County, exclusive of the Los Alamos National Laboratory, consume about 2100 terajoules (TJ) of energy annually. 43% of that is in the form of natural gas, used primarily for space and water heating. 20% is electrical energy. The balance, 37%, is the energy content of petroleum-based fuels for motor vehicles.

Altogether, there has been little change in primary energy use in LA since 2000.

Natural gas use has been declining by an average of about one-half percent per year throughout the period as our climate has warmed. Electricity use rose about 3% per year until it peaked in 2005. Average annual usage has varied, but there is no sustained up or down trend since. Reliable petroleum-based fuel (gasoline and diesel oil) data is only available since 2006. Use of petroleum fuels fell more than 10% in 2008, but rebounded half of that. 2008 saw high fuel prices and rapid growth of the new Atomic City Transit local bus service. Petroleum use started a slow rise in 2013. 2018 saw the highest petroleum use in the period. 2020-22 saw a 50% drop during the COVID-19 pandemic.

About 5% of LA’s total energy comes from renewable non-hydrocarbon sources as roughly 25% of its electricity is produced from hydroelectric plants. Most of the remaining electricity comes from hydrocarbon (coal and natural gas) steam plants. Natural gas, coal, and petroleum fuels are all hydrocarbons.

Carbon dioxide and CO_2-equivalent emissions associated with combustion of hydrocarbon fuels total about 185,000 metric tons annually. 49% is from natural gas. 23% is associated with electrical power generation. 28% is emitted by motor vehicles burning petroleum fuels. An additional 9,000 metric tons per year of CO_2-equivalent greenhouse gasses evolve from municipal solid waste disposed of by LA citizens.

This report could be improved upon. Suggestions are included.

ENERGY USE AND GREENHOUSE GAS EMISSIONS IN LOS ALAMOS COUNTY: 2000 - 2023

1 Introduction

Los Alamos (LA) county government formally committed in 2007 to "pursue independence from hydrocarbon energy sources."[1] That adopted strategic objective disappeared four years later. But LA citizens continue to have a strong sense of environmental stewardship, of which reducing greenhouse gas emissions is one major component. Establishment of concrete goals in that pursuit requires a baseline of historic data on LA's energy use and consequent greenhouse gas emissions. Carbon dioxide (CO_2), a "greenhouse" gas is released in combustion of hydrocarbon (CH) fuels. Other greenhouse gasses (GHG) escape from the CH fuel supply chain and evolve from decomposing municipal solid waste (MSW). This document summarizes available data for the County, excluding the Los Alamos National Laboratory (LANL), for both energy use and resultant GHG emissions for the period 2000-2023. It does not include emissions associated with consumable products.

This document follows much of the same methodology contained in the 2006 report, "Powering Los Alamos through the 21st Century: Could the Energy City be Energy Independent?" by the ad hoc group Energy Independent Los Alamos.[2] More motivation and detail can be found in that report. The present document supersedes, updates, and corrects errors in similarly-titled earlier reports in 2010, 2012, 2013, 2015, 2016, 2019, and 2021.[3]

2 Energy Use

Energy is imported into and used in Los Alamos in three primary forms: natural gas (largely methane, CH_4) principally for space and water heating, electrical power, and petroleum-based gasoline and diesel oil.

2.1 Natural Gas

Natural gas is supplied to the community through the LA County (LAC) Department of Public Utilities (DPU). Complete and detailed use data are available for many decades.[4]

Monthly and annual natural gas use is shown in Figures 2.1A & B. Units are k therms (1000's of therms). One therm equals 100,000 BTU's. These figures depict data tabulated and explained in Appendix A2.1 which are, in turn, derived from LAC DPU reports.

Figure 2.1A shows the expected seasonal variation in natural gas usage. Natural gas use should correlate with heating demand, which can be represented by heating degree days. The midsummer minimum gas usage is approximately 200 k therms per month. This is presumably the amount used in warm weather for water heating, cooking, clothes drying, and pilot lights. Above that baseline, each heating degree day in a winter month results in approximately 1250 therms of gas use and less in the other seasons. The scale for heating degree days (right side of figure) is offset to reflect a 200,000 therms per month baseline and the scale factor of 1250 therms per degree day.

Correlation is excellent in winter, when gas use is highest, and qualitatively quite good through the entire year. The overall annual demand for natural gas averages 1110 therms per heating degree day.

Figure 2.1B shows annual natural gas use and heating degree days. Heating requirements (as represented by heating degree days) over the period have declined an average of about 0.33% per year. Annual natural gas use has declined an average of about 0.44%.

2.2 Electricity

Electrical power is also supplied to the community through LAC DPU.

Monthly and annual electricity usage is shown in Figures 2.2A & B. Units are megawatt-hours (MWh). Figure 2.2A shows that electricity use is slightly higher during summer and winter than spring and fall. Summer demand peaks are driven by water pumping and, increasingly, air conditioning. Winter demand peaks arise from additional lighting, cooking, water heating, electronic entertainment, etc.

From Figure 2.2B, it can be seen that usage rose steadily by an average of about 3% per year until 2005. There is no clear trend since then; annual use appears to be nominally steady. Figure 2.2B also shows the portion of LA's total electric power derived from CH-fueled (coal and gas) power plants, hydroelectric dams, and LAC DPU's solar array at the old landfill. Hydroelectric production dropped sharply in 2014 when the El Vado generator was removed from service for major maintenance and further in 2015 when the Abiquiu generator was shut down for dam maintenance by the Corps of Engineers. Both hydro plants were back on line in early 2017, but continue to have intermittently-limited output due to both plant-related and dam-related issues.

Figure 2.2 is derived from data supplied by LAC DPU. Appendix A2.2 shows the data in tabular form and discusses issues associated with its extraction from DPU reports. [5]

2.3 Petroleum Fuels

The amount of petroleum-based motor vehicle fuels dispensed in the county, starting in 2006, is depicted in Figure 2.3A. Data for prior years are not considered reliable.

Motor vehicle fuel use shows little systematic seasonal or monthly variation. Most monthly spikes and dips, such as in early 2009, are presumably reporting artifacts. There was a significant decline in usage, more than 10%, from late 2007 through the end of 2008. The two factors that may have accounted for this drop were the high price of gasoline and the initiation (in October, 2007) and rapid growth of Atomic City Transit service. The partial recovery in 2009 suggests both were factors. A slow decline in apparent petroleum use reversed sharply in 2013, after the new Smith's station opened. The cause of the apparent drop in 2019 is unknown; a reporting change would be most likely. The COVID pandemic greatly reduced motor vehicle travel in 2020-22. Fuel use dropped by approximately 50% during many months. The relatively high usage rate in May-October of 2020 is a mystery. It may not be real.

This data includes fuel sold or otherwise dispensed within LA County. It is a reasonable guess that it approximates what is actually used within the county. It is known that maybe one-fourth of gasoline is sold to customers with addresses out of the county, presumably mostly commuters and tourists. Local residents presumably also buy fuel “off the Hill” and use it here. The two offset one another to some unknowable degree. It is assumed for this work that local use equals the amount locally dispensed.

More than 80% of petroleum used locally is in the form of gasoline sold through privately-owned service stations whose owners are under no obligation to make their sales information public. They do report it to the NM Dept. of Taxation and Revenue (NM TRD), which aggregates sale amounts by locality since some portion of the state tax on gasoline is returned to local governments. NM TRD has kindly provided monthly total amounts of taxable gasoline dispensed in LA County.[6] Diesel sales add an estimated 10% to that amount and gasoline untaxed at the pump adds another estimated 5%. Los Alamos County government and Los Alamos Public Schools largely fuel their own vehicles and have also supplied their data for this report.

Appendix A2.3 shows the petroleum fuel data in tabular form and discusses the many issues associated with it. Uncertainties are greater than with LAC DPU data for natural gas and electricity, but appear to be both approximately correct (based on discussions with local vendors) and reasonably consistent since 2006. NM TRD data for years prior to 2006 is too inconsistent to be relied upon.

2.4 Total Primary Energy Use

Natural gas and electricity are measured commercially in units of therms, and watt-hours, respectively. Both are units of energy. Petroleum fuels are measured in gallons, a unit of liquid volume, not energy. However, petroleum fuels have fairly consistent energy content per gallon so volume can be converted to energy content. (Details are in Appendix A2.4.) This is a theoretical energy content of the fuel. Its conversion to useful work in a motor vehicle is very inefficient, less than 10%.

A comprehensive picture of energy use requires conversion of the various commercial units of measure to one common unit. The standard (MKS) scientific unit of energy is the Joule. For present purposes, the terajoule, TJ (1 TJ = 10^{12} Joules) is a more conveniently sized unit.

Conversion factors are:[7]

1 therm = 1.055×10^{-4} TJ
1 MWh = 3.600×10^{-3} TJ
1 gallon = 1.33×10^{-4} TJ (average energy content)

Appendix B provides a more complete table of conversion factors.

Monthly and annual summaries for each form of energy and the combined total, all in terajoules, are shown in Figures 2.4A & B. Figure 2.4B also shows how much of that total annual use is derived from hydrocarbon fuels. It is about 95%. Details are in Appendices A2.2 and A2.4. Average annual energy use totals for 2011-2023 are depicted in Figure 2.4C.

Fig. 2.1A. Monthly Natural Gas Use Correlated to Heating Degree Days

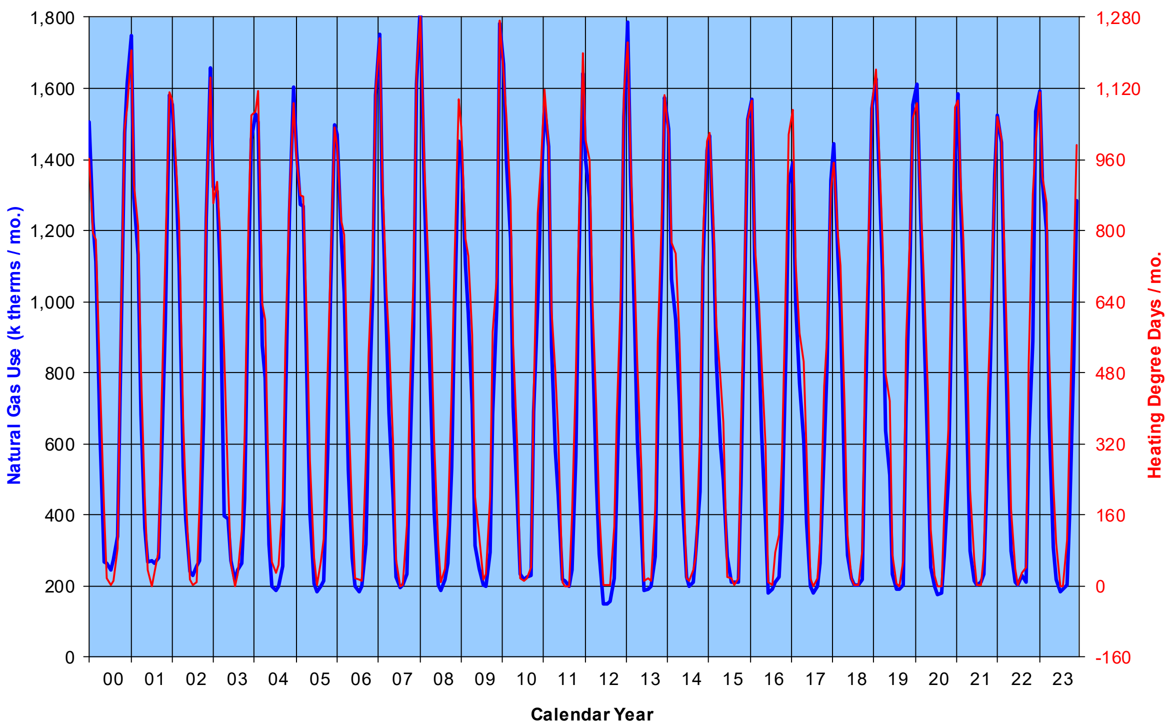


Fig. 2.1B. Annual Natural Gas Use Compared to Heating Degree Days

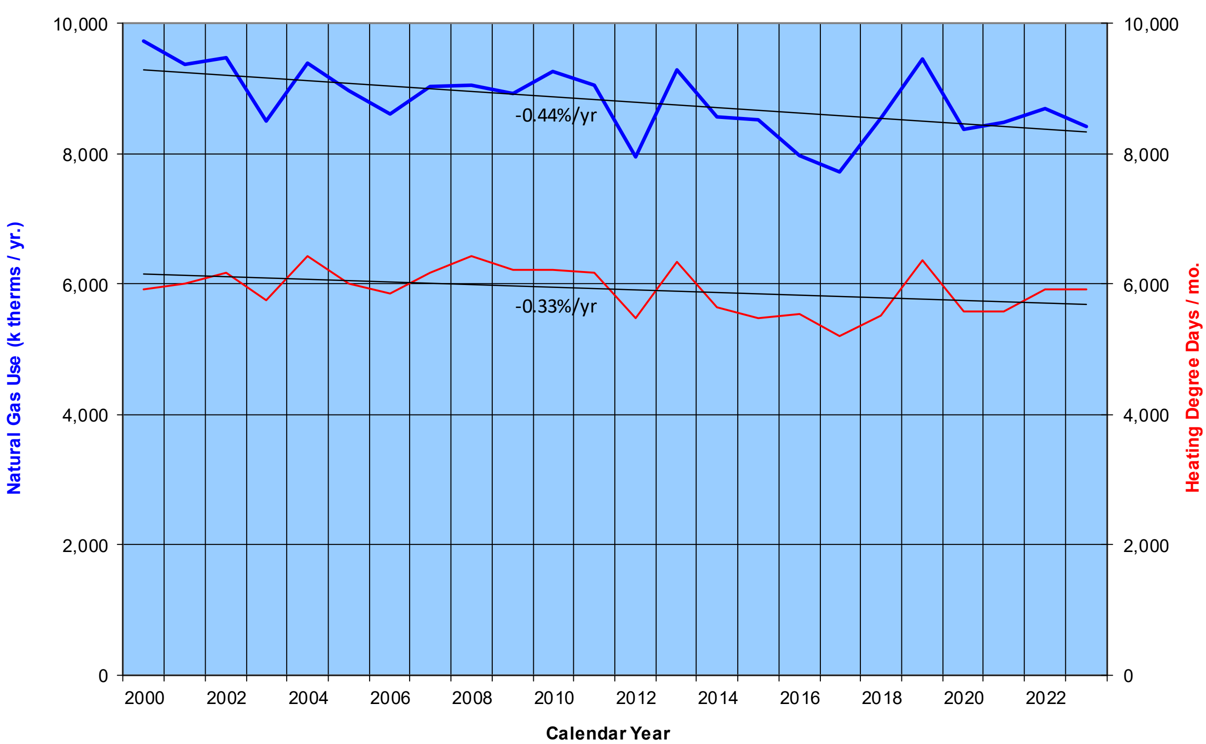


Fig. 2.2A. Monthly Electricity Use

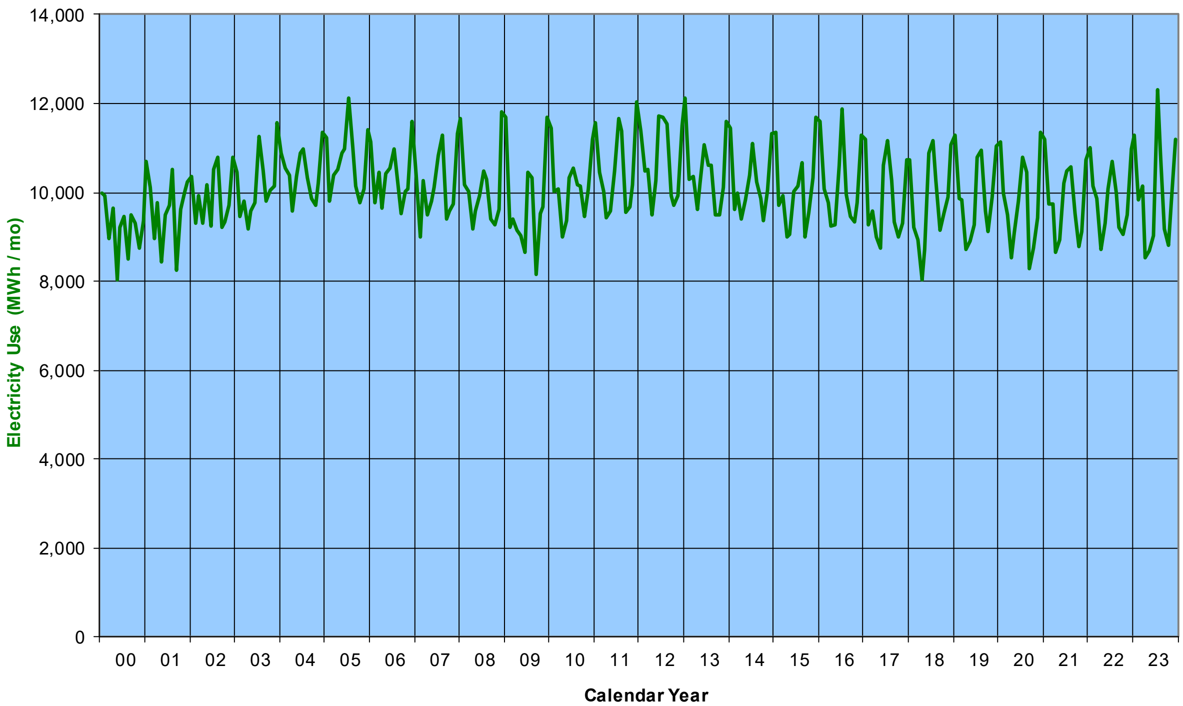


Fig. 2.2B. Annual Electricity Use & Sources

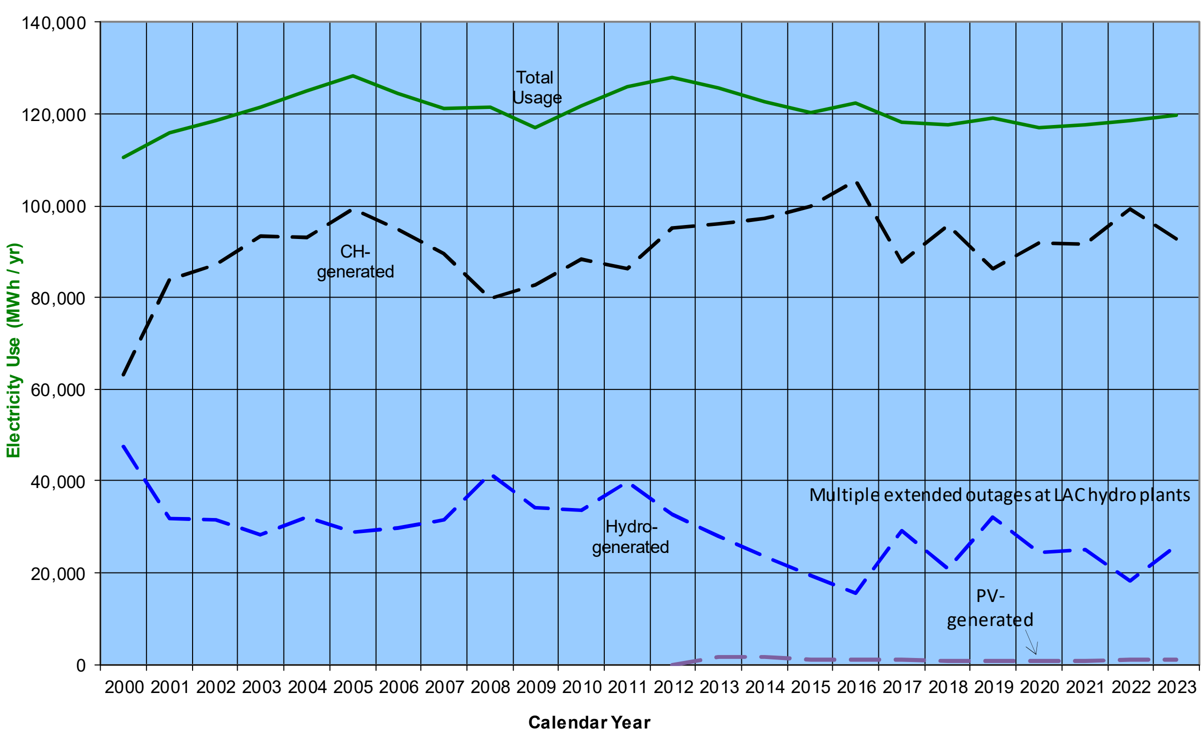


Fig. 2.3A. Total Petroleum Fuels Dispensed

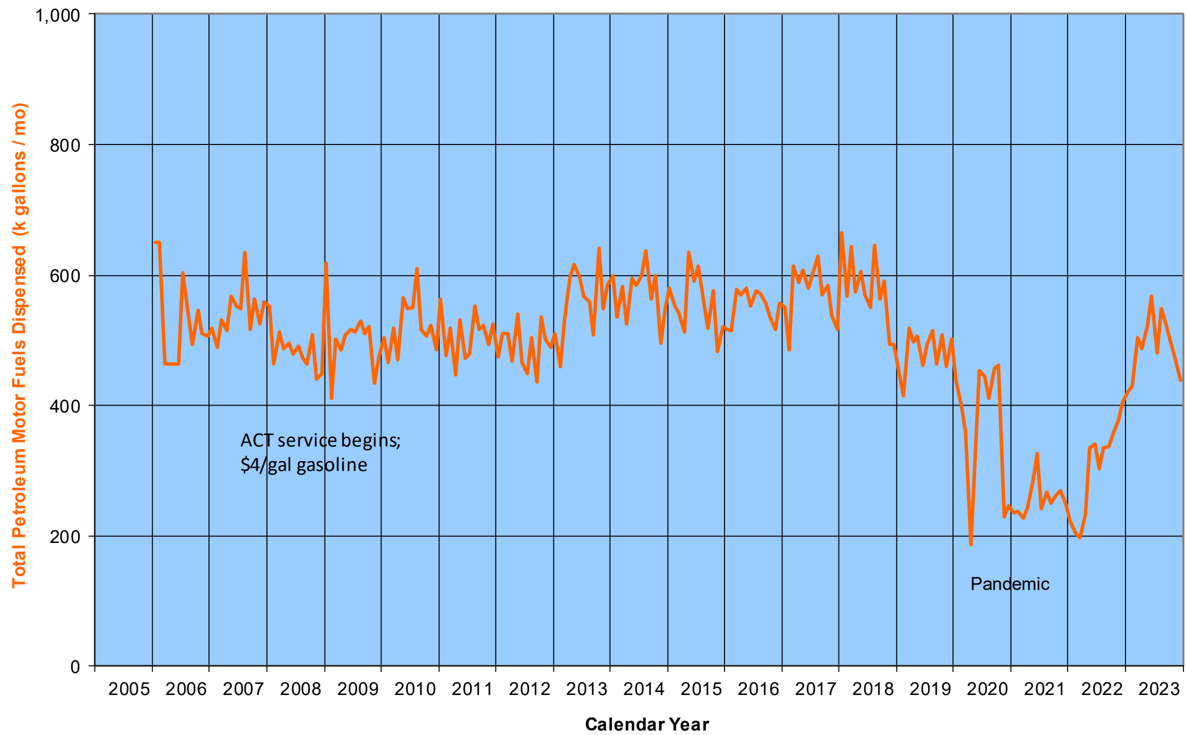


Fig. 2.3B. Annual Petroleum Fuel Use

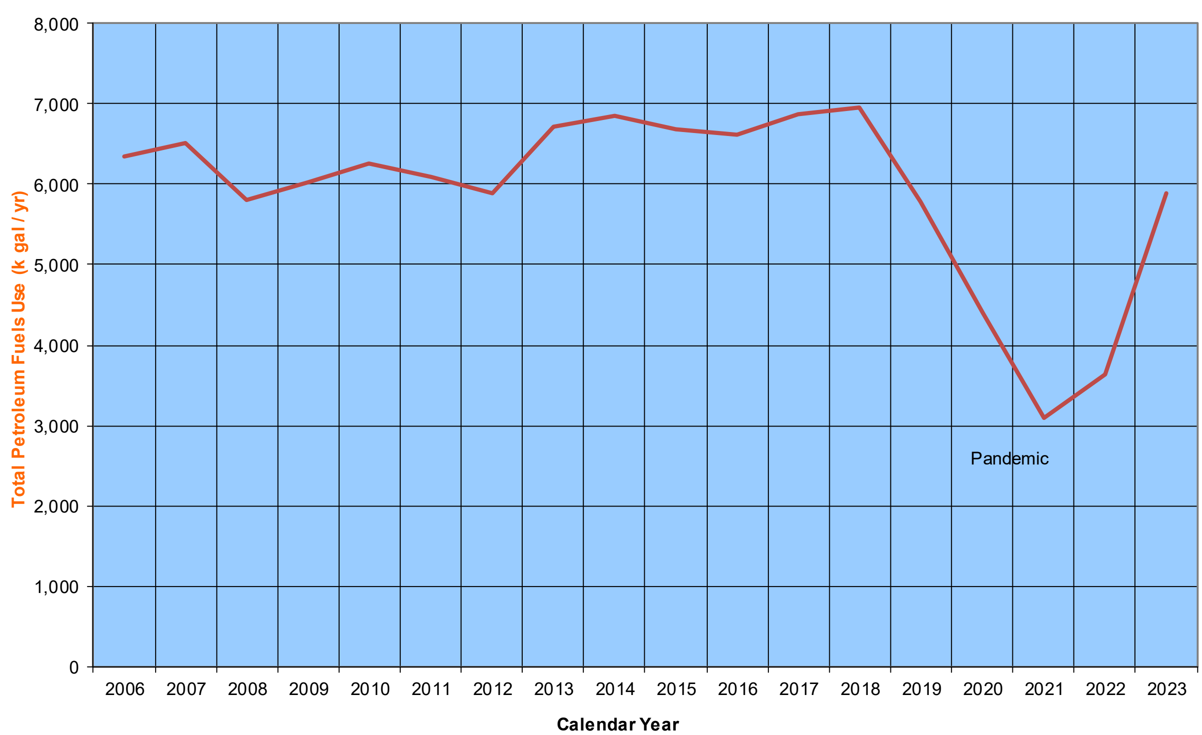


Fig. 2.4A. Monthly Energy Use

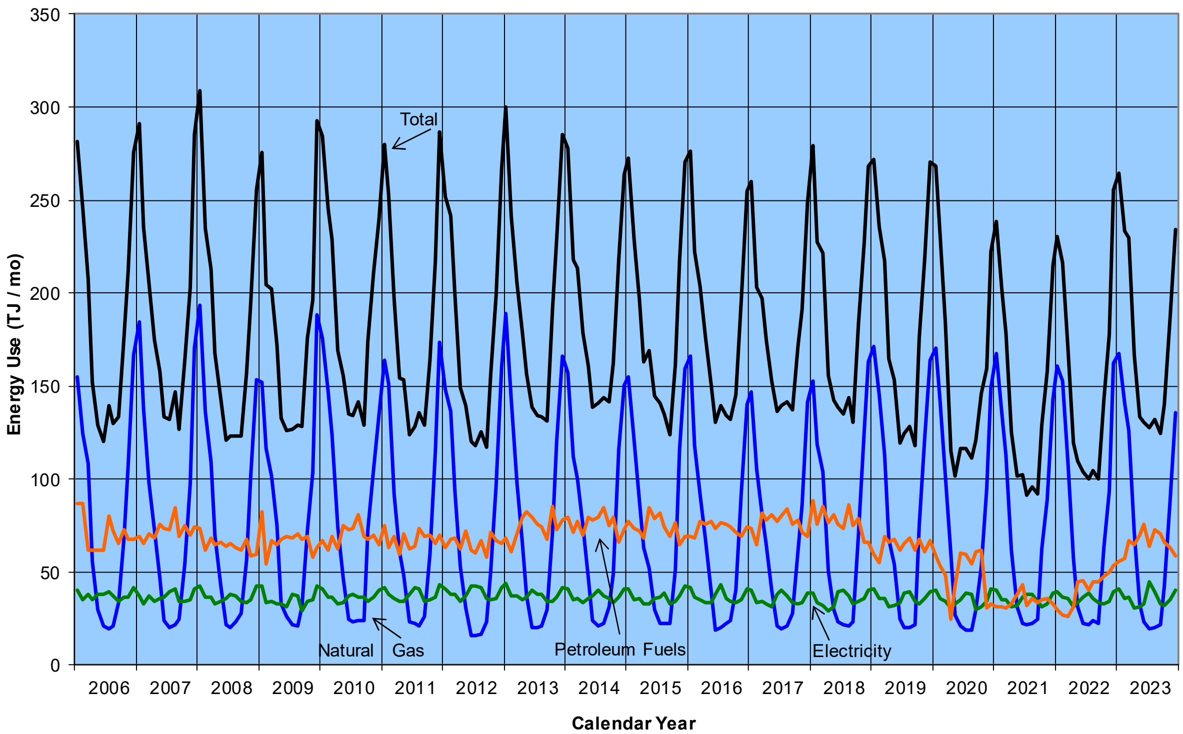


Fig. 2.4B. Annual Energy Use

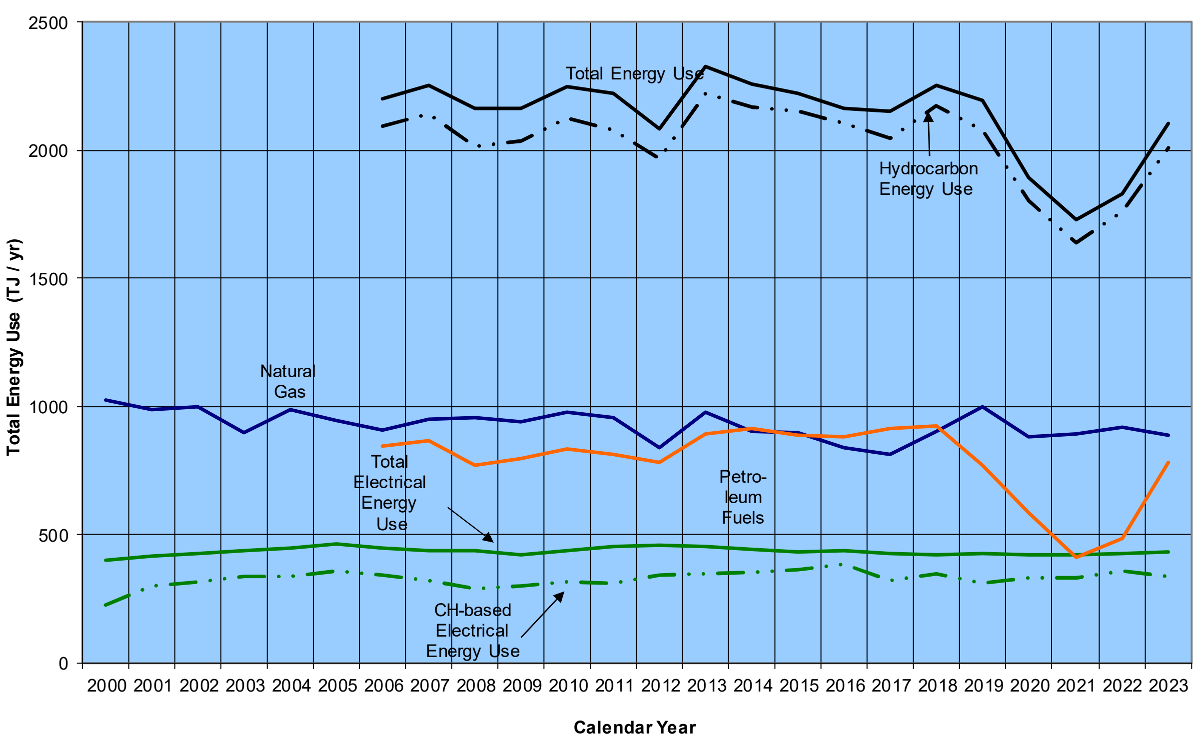
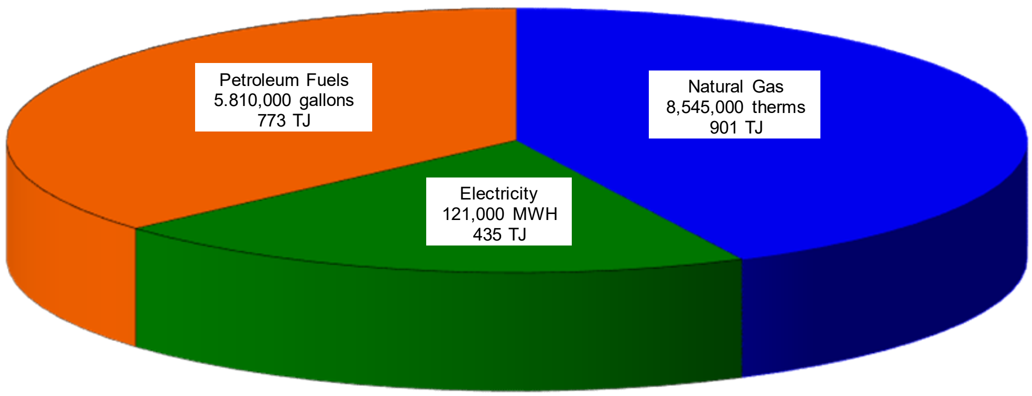


Fig. 2.4C. Average Annual Energy Use
2011 - 2023



Total = 2,110 TJ / yr

3 Greenhouse Gas Emissions from Hydrocarbon Fuels

Combustion of hydrocarbon fuels produces water (H_2O) principally as a vapor, CO_2 which is also a vapor, and small quantities of other gasses and particulate by-products. The water produced by combustion is small compared to the moisture already present in the atmosphere and has little environmental impact. CO_2 is a "greenhouse" gas, generally believed to affect the global climate. Different fuels produce different amounts of CO_2.[8] Again, a common measure is needed. This document uses mass (in kilograms) of carbon dioxide. A metric ton (mt) is 1,000 kilograms.

Combustion of natural gas produces about 50 mt of CO_2 for each terajoule of thermal energy produced. Natural gas is primarily methane, CH_4, which has about 28 times more global warming potential than CO_2 (over 100 years).[9] Natural gas leaks into the atmosphere from well fields, transmission lines, and incomplete combustion. Well field emissions are by far the largest of these. LA gets most of its gas from the Permian Basin, the second-leakiest well field in the country. A conservative estimate of the total leak rate is 3.6%, as discussed in Appendix A3.1. Thus, the global warming contribution from these fugitive emissions of natural gas is comparable to that from burning it. While not rigorously correct, this report will call that combined effect of both gasses CO_2-equivalent or CO_2e, 100 mt per terajoule of thermal energy. Well field and most transmission leaks are physically remote, but are part of the process by which gas is supplied to LA county. LA end users are thus responsible for them.

LA County and LANL pool their electrical power resources into a Los Alamos Power Pool (LAPP) through an Energy Coordination Agreement (ECA). The majority of LAPP's electricity originates in steam power plants which burn coal or (increasingly) natural gas, both hydrocarbons. The burning of coal produces about 125 mt of CO_2 for each terajoule of electrical energy produced. While the CO_2 is actually emitted into the atmosphere at power plants remote from LA, again local usage is certainly responsible for it.

A substantial fraction, roughly 21% in recent years, of LA's electrical power is hydroelectric in origin. (Since 2000, the actual annual amount has varied from 13% to 43%; see Table A2.2.2. Percentages were in the lower part of this range during the last decade when the El Vado and/or Abiquiu hydroelectric plants were frequently off-line for various reasons.) Electricity generated from hydroelectric or other renewable resources such as wind, solar, etc. produces no CO_2 during generation itself.

Both gasoline and diesel fuel produce approximately 67 tons of CO_2 for each terajoule of energy content in the fuel.

Total monthly CO_2e production from all three forms of primary energy is depicted in Figure 3.4A, starting with 2006. Figure 3.4B shows the annual totals starting with 2000. Average annual CO_2e production for 2011-2023 is depicted in Figure 3.4C.

Another significant emitter of greenhouse gasses is municipal solid waste, considered separately in Sec. 4.

Fig. 3.4A. MONTHLY GREENHOUSE GAS EMISSIONS

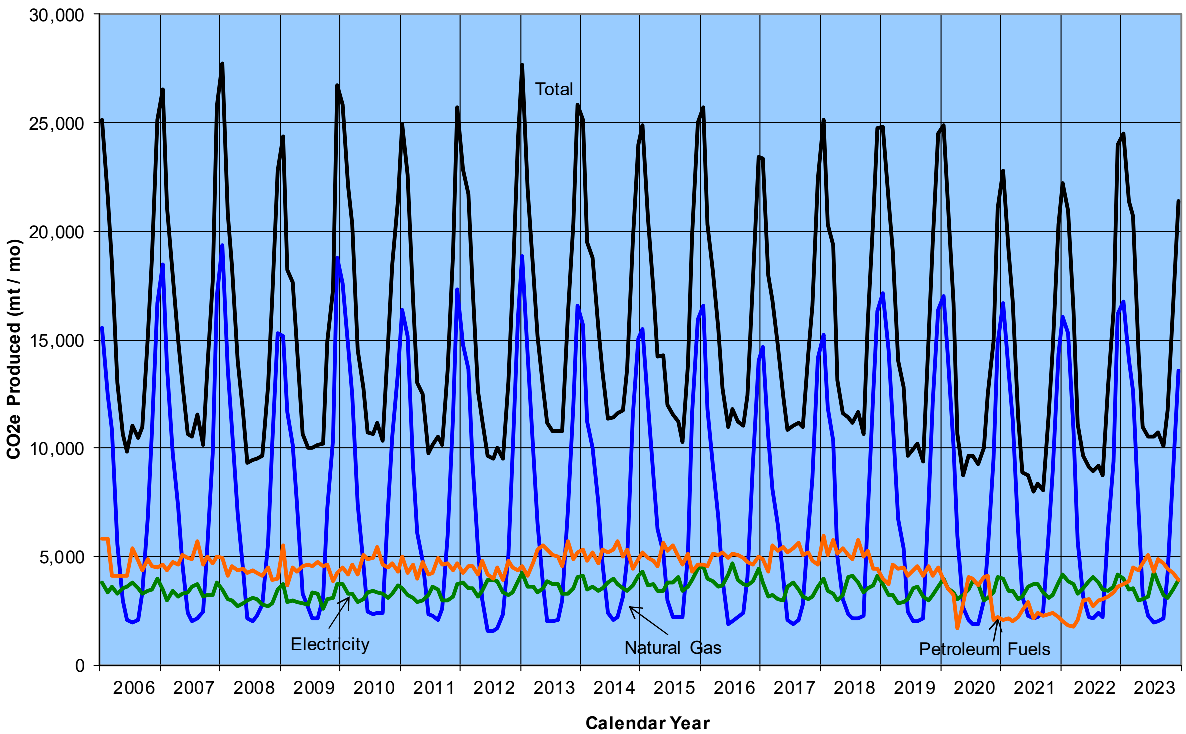


Fig. 3.4B. ANNUAL GREENHOUSE GAS EMISSIONS FROM HYDROCARBON FUELS

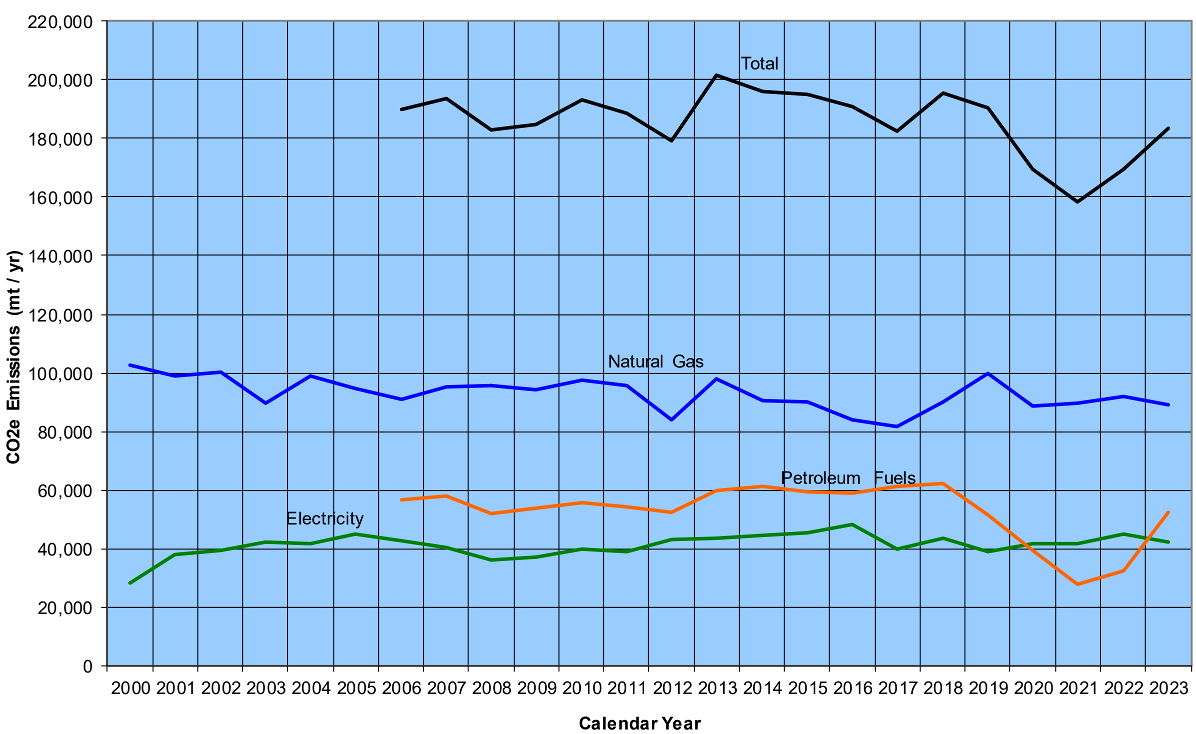
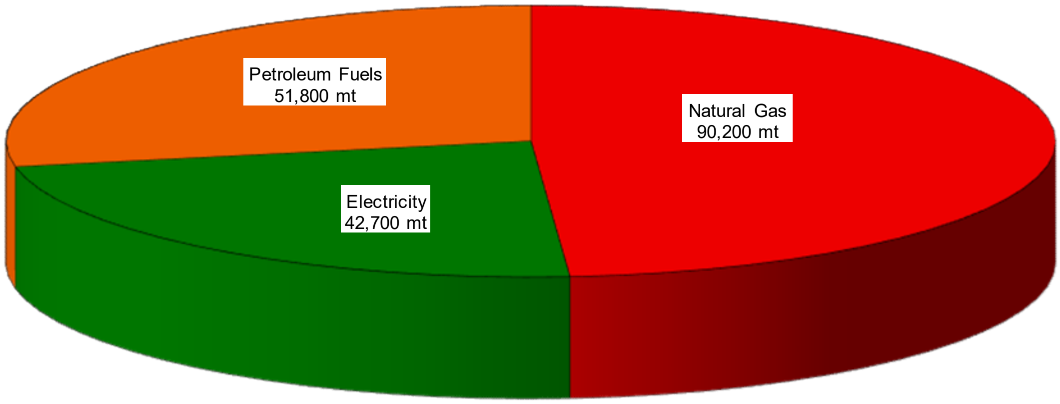


Fig. 3.4C. Average Annual Greenhouse Gas Emissions from Combustion of Hydrocarbon Fuels 2011 - 2023



Total = 184,700 mt / yr

4 Municipal Solid Waste

A fourth significant source of greenhouse gas emissions is decomposition of the materials we use and dispose of every day. There is no practical way to measure the CH content of products we acquire nor the amount of CO_2 or other greenhouse gasses associated with their manufacture or shipment. But solid waste can be measured, since virtually all of it is disposed of through LAC's Environmental Services Division (LAC ESD). Much is diverted to reuse. The balance either ends in the County landfill (prior to 2009) or is hauled to other landfills.

Solid waste handled by LAC ESD includes significant quantities from LANL and, years ago, Espanola. In the early years after the Cerro Grande Fire of 2000, it included a great deal of debris and waste associated with demolition and reconstruction. Recycling of concrete and asphalt began in 2004 and was fully implemented in 2005. Hence, data from years before 2006 is difficult to use for true baseline purposes. LAC ESD data on the total amount of waste attributed to the LA community is shown in Figure 4.1. (Note: this data is in short tons, 2000 lbs, not metric tons as used elsewhere in this report).

In a landfill, MSW slowly decomposes, evolving primarily methane (CH_4) and CO_2. As noted earlier, CH_4 is also a greenhouse gas, 28 times more effective (over 100 years) per unit of mass at trapping heat in the atmosphere than CO_2. As it decomposes over many years, each short ton of MSW deposited in a landfill will evolve a total of about 0.58 metric tons of CO_2e in greenhouse gasses.[10] That amount it also shown in Figure 4.1.

Average annual CO_2e production in LA County for 2011-2023, with MSW included, is depicted in Fig 4.2.

Fig. 4.1. Municipal Solid Waste

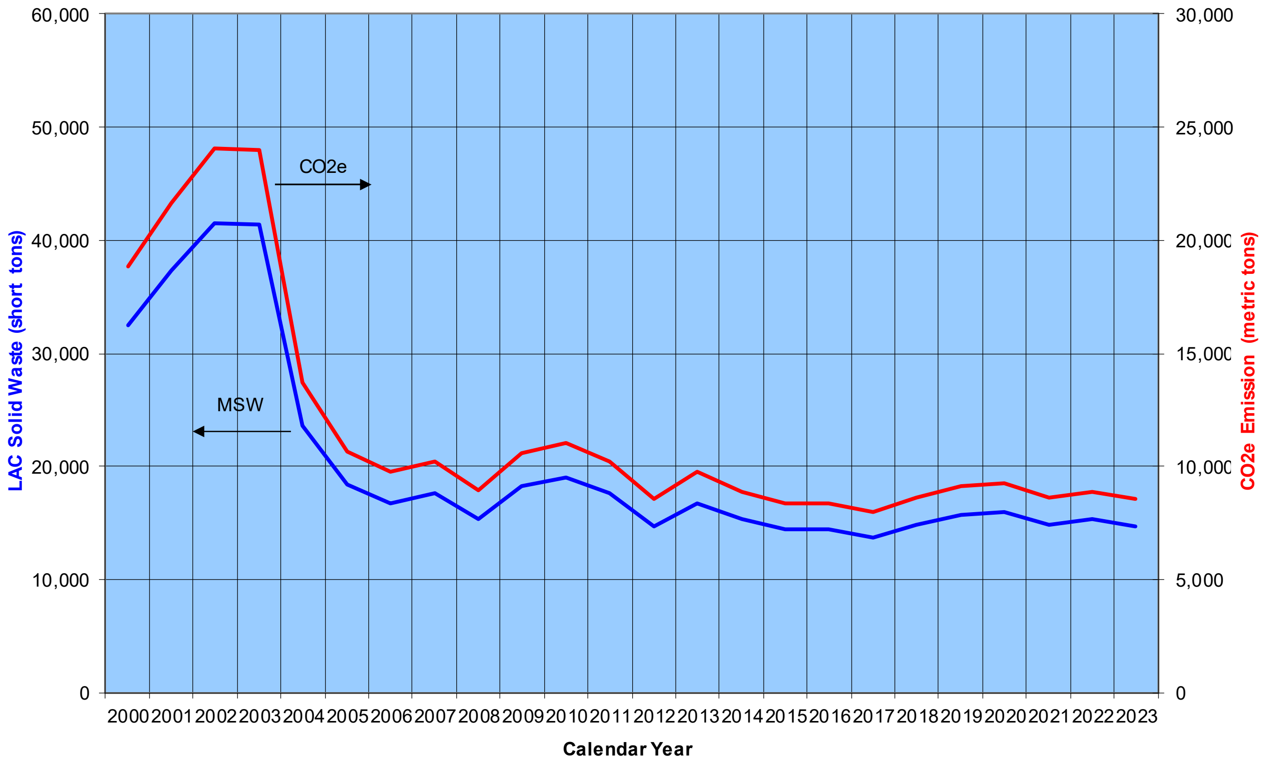
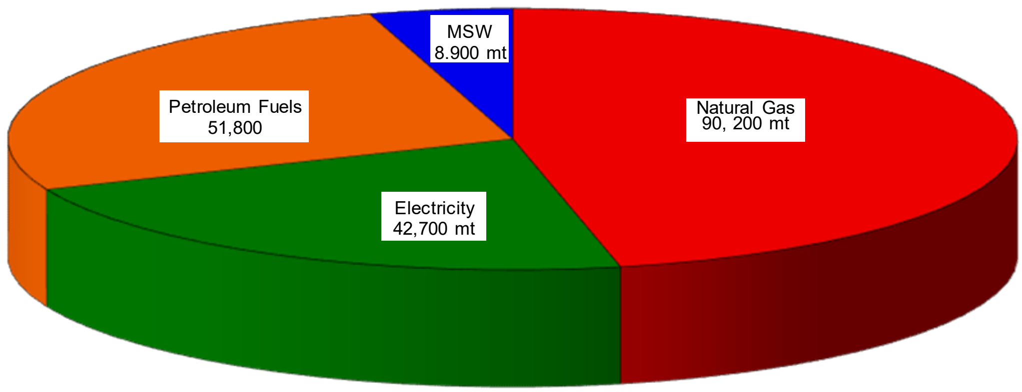


Fig. 4.2.
Average Total Annual Greenhouse Gas Emissions
from Hydrocarbon Fuels and Municipal Solid Waste
2011-2023



Total = 193.500 mt / yr

5 Observations

The slight decline in natural gas use appears due largely to lower demand thanks to the warming climate.

The amount of gas used for water heating, cooking, clothes drying, and pilot lights presumably increases during colder weather, but there is no way to determine how much from overall use data. Even at summer baseline levels, uses other than space heating account for 2.4M therms annually or at least 25% of natural gas use. The actual percentage is higher. These uses for purposes other than space heating may be fertile ground for CH use reduction by converting to solar water heating, electric (preferably induction) ranges, and electric ignition of gas appliances.

Stabilization of electricity use since 2005 after years of steady increase (extending back well before 2000) is surprising and encouraging. Long-term, electricity use is expected to increase as buildings are electrified and electric vehicles become more common.

The significant decline in petroleum-based fuel use in 2008 and 2020 shows that "behavior change" is possible. The effects of technological change (electric-drive and more efficient internal combustion vehicles) have not yet been realized to any significant degree.

Although LA's overall use of hydrocarbon energy has not decreased significantly, the fact that it has not increased for two decades is encouraging since there has been no concerted local effort until very recently to actually "pursue independence from hydrocarbon energy sources." Those efforts will take time to have noticeable impact.

Municipal solid waste comprises roughly five percent of LA's GHG emissions. Additional recycling and/or application of modern technology (power generation from the evolved CH_4 or simply flaring it) at the landfills to which it is now hauled could reduce this component of LA's "carbon footprint" significantly.

The COVID pandemic began in March, 2020, and slowly abated through the latter half of 2021. It had no noticeable effect on natural gas or electricity use. It had a large effect on petroleum fuel use and related emissions, which did not return to pre-pandemic levels until very early 2023. This had a significant effect on total energy use and GHG emissions. Averages that include this period are affected slightly.

6 Potential Improvements

This methodology and database were originally developed primarily to provide a factual basis for policy decisions and community action and as a baseline against which to measure progress on actual reductions. They appear adequate to serve both of those purposes going forward. Refinements are certainly possible, resources permitting. Possible improvements are outlined below,

6.1 Natural Gas

Usage data comes directly from DPU Consumption Reports. These reports include some LANL or LANL contractor-owned or leased properties physically located within the community. Since the intent is to exclude LANL, separating these properties would allow their usage to be removed from community usage.

The CO_2e emission factor for natural gas is dominated by fugitive well head emissions, which are quite uncertain. With the increased recognition of their magnitude nationally in recent years, better measurements should become available and should be incorporated.

Quantitative correlation of natural gas use with heating degree days would likely be improved if the reference temperature of 65º F used by LANL (and very commonly elsewhere) were adjusted downwards. In LA's sunny climate, little artificial heat is required until temperatures drop well below 65º. This refinement may not be possible or worth the effort.

6.2 Electricity

Usage data also comes from DPU Consumption Reports. As with natural gas, LANL-related properties could be separated to get a more accurate picture of non-LANL community consumption.

It may be possible to track ultimate sources of purchased power and their emission factors. Overall emission factors will then vary and could be incorporated into emission calculations vs. the single unchanging factor now used.

Electricity generated by distributed sources ("rooftop photovoltaic") and provided to DPU actually offsets consumption in DPU Consumption Reports. DPU is currently separating that generation and consumption. Then they can be incorporated in this report correctly.

This report uses annual averages for hydroelectric production. Monthly data is available in DPU reports. It would be straightforward to incorporate.

6.3 Petroleum Fuels

Accuracy of the methodology used is uncertain. Taxable gasoline sales are presumably quite accurate. Estimates of non-taxable gasoline and diesel fuel are very rough. They don't have a large effect if they are small, as estimated. Better estimates can likely be made from vehicle registration and other data.

The major uncertainty lies in how much fuel LA residents buy off the Hill vs. how much non-residents buy in LA. A survey question could shed light on the former.

6.4 General

Emission factors used in the report were gathered from various sources at various times. Some are 12-15 years old. They should all be reviewed, updated, and preferably based on a single, authoritative, current source.

DPU has data for electricity and natural gas (and water) usage by different categories: residential, commercial (which includes some LANL and some residential), county government, and schools. Tracking by these categories would be straightforward and yield some deeper insight into usage patterns, potential leverage, and changes over time.

Los Alamos is in the unusual position of being able to track its actual energy consumption. Most communities must rely on models based on population, number of housing units, number of motor vehicles registered, etc. LA could contribute to the science of energy use and greenhouse gas emission management by comparing various models to its actual data and thereby helping to validate or improve the available models. (Thesis project, anyone?)

Some of the cited reference links are "dead." Links should be reviewed for current status and accuracy.

6.5 Ownership

This report has been developed and maintained over the years by the author as a personal project. If it is to be used on an on-going basis, its maintenance could be transferred to County staff while the owner is available to assist the transition.

7 Acknowledgements

The author is only the compiler of data available from public sources. Many people have made data available and helped in its interpretation. John Arrowsmith, Janet Bettinger, Karen Kendall, Cathy Crane (now D'Anna), Angela Keiter, Steve Cummins, Jordan Garcia, Joann Gentry, and others of LAC DPU helped interpret DPU's myriad reports and identify and reconcile numerous anomalies in the original data. Libby Gonzales and Theresa Smith of the Revenue Processing Division of NM TRD supplied gasoline sales reports which Jim Polk and Ross Van Lyssel helped interpret. Marina Wells, Reyann Nastacio, and Faith Gallegos of LAC Dept. of Public Works supplied data on fuel dispensed by the county government while Keith Rosenbaum and Audrey Washburn of LA Public Schools have reported LAPS fuel use since 2010. LANL's Environmental Data and Analysis Group (now EPC-CP) supplied monthly weather summaries beyond those presently posted on the LANL Weather Machine. Regina Wheeler, Tom Nagawiecki, Juanita Salazar, Angelica Gurule, and Joshua Levings of LAC ESD "sorted the trash" to estimate how much of the refuse received by LAC actually originates with LA residents (vs. LANL and other communities), evaluated various models for GHG emission from MSW, critically reviewed earlier drafts of this document, and made many valuable suggestions, as did members of the LAC Environmental Sustainability Board. Thank you all.

In spite of all the help, errors undoubtedly remain. Except for some cases where original data may not be accurate, any errors of transcription, calculation, or interpretation remain solely the responsibility of the author.

APPENDIX A

This Appendix provides data tables from which the graphical figures in the main body of the report are derived. It also discusses sources, issues, conversion factors, etc. associated with the data.

A2.1. Natural Gas

Natural gas imported into the county, starting in January, 2000, is summarized by month and county fiscal year (FY, July – June) in Table A2.1.1A.[4] During most of that period, LAC DPU reported gas imports one month after they actually occurred, except for FY 2002-04 when they were reported during the actual month in which they occurred. DPU returned to reported during the current month in July, 2023. Months in which gas was sold to LANL for use at the TA-3 power plant are denoted in Table A2.1.1A by italicized totals. Shifting the data to the actual month of import, subtracting sales to LANL, and reorganizing by calendar year provides the monthly summary of actual gas used in Table A2.1.1B.

Table A2.1.2 (on p. 23) lists heating degree days in each month as reported by LANL.[11,12]

A2.2. Electricity

Monthly electric power imports since 2000 are summarized in Table A2.2.1A, arranged by fiscal year.[5] Table A2.2.1B lists energy output from the landfill solar photovoltaic array through April, 2021. Data after that date was lost due to equipment failure. Data from CY 2020 is used and shown in the chart in italics. Table A2.2.1C shows total electric power used, arranged by calendar year. LAC DPU reports electricity imports in the month in which they actually occur.

LA County and LANL pool their electrical power resources into a Los Alamos Power Pool (LAPP) through the ECA. Until the San Juan Generating Station was shut down at the end of September, 2022, the majority of LAPP's electricity originated in coal-fired steam power plants. (Coal is a hydrocarbon.) A substantial fraction is hydroelectric in origin. Table A2.2.2 lists the total amount of electricity consumed annually by LA county and LANL and that which is produced by various hydroelectric resources within LAPP.[13] From this data, annual average percentages attributable to hydroelectric and CH-based production can be derived. In recent years, LAPP has purchased significant amounts of electricity (up to 39% of its total needs in CY 2016 and then a majority after San Juan closed) on the energy market. Original sources of this electricity are not presently tracked, although they may be in the future. Most grid power produced in NM is coal- or gas-based.[14] For present purposes, it is assumed all CH power used by LAPP is produced in coal-fired plants. This may change in the future, as natural gas is likely to fire more steam power plants. Solar and perhaps wind sources will also become significant.

A2.3 Petroleum Fuels

Petroleum-based motor vehicle fuels are supplied mostly through private distributors, who are under no obligation to disclose their sales. They must, however, report to the NM Taxation and Revenue Department (NM TRD) which tracks taxable gasoline sales by location because a certain amount of gasoline tax is returned to local governments. NM TRD has supplied aggregate monthly taxable gasoline sales data for LA county, starting with January, 2005.[6] Sales reported by NM TRD are listed in Table A2.3A.

NM TRD data is challenging in several respects. Prior to mid-2006 it was quite "noisy." The number of distributors reporting varied considerably from month to month. The large dip and rise in two successive months in early 2005 and again twice in early 2006 suggest a large part of the sales in the first month of each of those cycles was either reported or recorded in the following month. The greater concern is the clear shift in baseline, from around 650,000 gallons per month in 2005 to around 450,000 in 2006 and later years. This is almost certainly a reporting artifact and not associated with a sudden, dramatic drop in gasoline usage. The stability of the data after mid-2006 suggests it is likely the most reliable. A more realistic accounting of monthly use in the first half of 2006 is obtained by averaging the taxable sales figures for January and February and also March through June of that year. This "smoothed" data is used for plotting Figure 2.3A.

Fuel dispensed in LA may not equal fuel actually consumed in the county. Many LA residents buy fuel "off the Hill," where it is often less expensive. Some commuters buy fuel in LA. It is assumed the two effects offset each other. That could be a significant error, underestimating petroleum use, as more fuel is likely to be imported into the county than exported via this mechanism.

Private distributors dispense small amounts of gasoline not subject to taxation. It is estimated at 5% of taxable gasoline sales. Diesel fuel is subject to taxation, but NM TRD does not track it by county. These sales are estimated at 10% of taxable gasoline sales.

LA County government and LA Public Schools also receive and dispense non-taxable fuels. Before 2010, data for the two entities was combined and reported as fiscal year (July – June) totals.[15] Monthly averages based on these annual totals are listed in Table A2.3C. In early 2010, the old County fueling facility at Trinity Site was replaced by the new one at Pajarito Cliffs. Some fuel use was not tracked during the transition. Since then, County and Schools fuel data[16] has been available monthly and is tabulated in Table A2.3C. It is unlikely that County and Schools use increased dramatically starting in 2010. It is likely that the more recent data is more accurate and the older data did not capture all use. The error is small compared to overall petroleum fuel use. (Note: LAPS usage for 2021-21 has not yet been provided. It will be included when available. Its use is no more than 1% of total petroleum usage so the missing data is of little consequence.)

Total estimated petroleum-based fuel use is shown in Table A2.3D, with averaging in the first six months of 2006 as previously discussed. This is the sum of taxable gasoline sales, estimated diesel fuel and non-taxable gasoline, and LA County and LA Public Schools use. This total, starting in 2006, is shown graphically Figure 2.3. Effects of the COVID pandemic are obvious. Petroleum use did not return to near pre-pandemic levels until February, 2023, three full years after the pandemic began.

A2.4 Total Energy Use

The commercial energy units for natural gas and electricity can be easily converted to terajoule units. For natural gas, 1 therm = 1.055×10^{-4} TJ. For electricity, 1 MWh = 3.600×10^{-3} TJ.

Table A2.1.1. NATURAL GAS USE

(k therms = 1000's of therms)

A. Natural Gas Imported (in preceeding month, including TA-3 sales)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	00-Pres Average
Jul		264	270	230	214	197	208	198	224	203	250	234	219	149	*230*	225	281	179	199	221	235	199	212	211	185	218
Aug		244	263	257	246	189	182	182	193	188	202	219	214	151	*526*	198	211	189	181	203	192	177	204	204	192	217
Sep		273	277	272	263	200	200	197	202	216	200	225	200	158	*293*	*212*	210	209	199	201	192	180	211	228	202	218
Oct		341	*1,934*	679	446	257	214	316	231	262	293	228	246	220	*313*	298	211	226	263	217	202	284	233	211	400	355
Nov		800	938	1,233	1,089	686	586	*1,015*	516	532	684	691	565	477	677	463	483	381	580	663	710	501	590	595	840	679
Dec		1,474	1,581	1,658	*1,493*	1,247	1,004	1,021	928	965	986	999	1,087	917	1,137	1,096	1,099	877	818	1,186	1,151	899	846	887	1,286	1,110
Jan	1,701	1,615	1,552	1,321	1,526	1,605	1,499	1,580	1,612	1,452	1,782	1,279	1,643	1,519	1,572	1,424	1,511	1,329	1,341	1,544	1,553	1,408	1,356	1,536	1,441	1,508
Feb	1,503	1,749	1,333	1,310	1,504	1,425	1,470	1,751	1,836	1,437	1,668	1,550	1,403	1,788	1,487	1,465	1,570	1,390	1,445	1,625	1,612	1,584	1,523	1,591	1,083	1,524
Mar	1,225	1,292	1,106	*1,188*	876	1,272	1,177	1,305	1,293	1,105	1,393	1,435	1,293	1,356	1,063	1,142	1,117	996	1,124	1,375	1,351	1,284	1,447	1,336	992	1,222
Apr	1,112	1,133	539	398	785	1,270	*1,058*	928	1,031	962	1,177	872	886	924	949	832	871	769	981	1,066	957	1,071	1,025	1,196	636	937
May	624	684	383	*445*	318	716	*544*	*708*	659	708	704	579	501	615	708	596	642	609	476	638	565	584	539	676	*350*	583
Jun	266	363	240	271	197	405	280	446	411	311	440	455	289	*355*	441	494	375	379	285	510	254	299	297	308	*150*	341
FY Total		10,232	10,418	9,263	8,957	9,468	8,423	9,647	9,137	8,341	9,777	8,766	8,546	8,630	9,395	8,446	8,580	7,535	7,891	9,450	8,973	8,470	8,484	8,979	7,756	8,898

B. Natural Gas Imported (to County, excluding LANL, during calendar month)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2011-23 Average
Jan	1,503	1,749	1,552	1,321	1,526	1,425	1,470	1,751	1,836	1,437	1,668	1,550	1,403	1,788	1,487	1,465	1,570	1,390	1,445	1,625	1,612	1,584	1,523	1,591	1,441	1,541
Feb	1,225	1,292	1,333	1,310	1,504	1,272	1,177	1,305	1,293	1,105	1,393	1,435	1,293	1,356	1,063	1,142	1,117	996	1,124	1,375	1,351	1,284	*1,447*	1,336	1,083	1,255
Mar	1,112	1,133	1,106	1,092	876	1,270	1,025	928	1,031	962	1,177	872	886	924	949	832	871	769	981	1,066	957	1,071	*1,025*	1,196	992	954
Apr	624	684	539	398	785	716	526	688	659	708	704	579	501	615	708	596	642	609	476	638	565	584	*539*	676	636	594
May	266	363	383	390	318	405	280	446	411	311	440	455	289	355	441	494	375	379	285	510	254	299	*297*	308	350	365
Jun	264	268	240	271	197	208	198	224	203	250	234	219	149	188	225	281	179	199	221	235	199	212	211	216		210
Jul	244	270	230	214	189	182	182	193	188	202	219	214	151	193	198	211	189	181	203	192	177	204	204	185		192
Aug	273	263	257	246	200	200	197	202	216	200	225	200	158	198	211	210	209	199	201	192	180	211	228	192		199
Sep	341	277	272	263	257	214	316	231	262	293	228	246	220	281	298	211	226	263	217	202	284	233	211	202		238
Oct	800	548	679	446	686	586	644	516	532	684	691	565	477	677	463	483	381	580	663	710	501	590	595	400		545
Nov	1,474	938	1,233	1,089	1,247	1,004	1,021	928	965	986	999	1,087	917	1,137	1,096	1,099	877	818	1,186	1,151	899	846	887	840		988
Dec	1,615	1,581	1,658	1,456	1,605	1,499	1,580	1,612	1,452	1,782	1,279	1,643	1,519	1,572	1,424	1,511	1,329	1,341	1,544	1,553	1,408	1,356	1,536	1,286		1,463
CY Tot.	9,742	9,367	9,484	8,496	9,389	8,981	8,618	9,024	9,049	8,918	9,257	9,064	7,964	9,283	8,564	8,534	7,966	7,723	8,546	9,450	8,386	8,476	8,703	8,426	4,503	8,545

Table A2.2.1. ELECTRICITY USE

(Megawatt-hours, MWh)

A. Electric Power Imported (by FY)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	2000-23 Average
Jul		9,444	9,699	10,515	11,254	10,962	12,133	10,983	10,833	10,468	10,451	10,555	11,655	11,684	10,440	10,996	10,050	11,822	11,103	11,103	10,724	10,741	10,412	10,638	12,238	10,811
Aug		8,497	10,517	10,794	10,495	10,326	11,004	10,378	11,292	10,308	10,312	10,184	11,387	11,549	10,473	10,116	10,577	9,910	10,208	10,208	10,879	10,388	10,491	9,897	10,765	10,443
Sep		9,499	8,263	9,195	9,792	9,863	10,126	9,521	9,409	9,395	8,151	10,145	9,560	9,914	9,412	9,748	8,924	9,320	9,262	9,067	9,471	8,201	9,411	9,103	9,067	9,337
Oct		9,315	9,602	9,341	10,051	9,696	9,757	10,022	9,597	9,273	9,509	9,450	9,679	9,694	9,332	9,237	9,476	9,200	8,894	9,464	8,997	8,660	8,633	8,909	8,683	9,382
Nov		8,751	10,008	9,693	10,128	10,202	10,063	10,086	9,722	9,622	9,683	10,070	10,176	9,913	9,993	9,928	10,271	9,647	9,229	9,833	9,805	9,373	9,048	9,399	9,717	9,767
Dec		9,379	10,244	10,777	11,553	11,358	11,400	11,596	11,306	11,808	11,691	11,199	12,039	11,517	11,537	11,235	11,643	11,191	10,688	11,053	10,975	11,314	10,673	10,934	11,149	11,179
Jan	10,000	10,702	10,368	10,449	10,899	11,213	11,123	10,400	11,658	11,688	11,439	11,568	11,389	12,026	11,315	11,269	11,529	11,121	10,657	11,387	11,058	11,148	10,948	11,231	11,520	11,108
Feb	9,923	10,111	9,307	9,458	10,540	9,789	9,778	9,005	10,171	9,201	10,014	10,451	10,476	10,167	9,484	9,606	10,045	9,153	9,164	9,807	9,890	9,680	10,063	9,758	9,864	9,793
Mar	8,966	8,970	9,913	9,790	10,387	10,387	10,450	10,256	10,013	9,395	10,063	10,006	10,516	10,196	9,807	9,803	9,629	9,409	8,826	9,751	9,430	9,675	9,794	10,067	9,636	9,813
Apr	9,630	9,776	9,307	9,171	9,567	10,497	9,656	9,479	9,180	9,154	8,994	9,440	9,476	9,492	9,234	8,869	9,119	8,849	7,943	8,632	8,453	8,567	8,653	8,447	8,739	9,149
May	8,030	8,442	10,183	9,583	10,344	10,898	10,426	9,810	9,597	9,017	9,366	9,585	10,265	10,024	9,688	8,956	9,159	8,599	8,615	8,833	9,011	8,859	9,218	8,593		9,379
Jun	9,209	9,501	9,248	9,771	10,898	10,963	10,545	10,103	9,931	8,660	10,322	10,476	11,714	10,911	10,245	9,907	10,486	10,457	10,803	9,194	9,727	10,120	10,020	8,964		10,091
FY Total		112,387	116,658	118,538	125,909	126,154	126,459	121,639	122,709	117,989	119,994	123,128	128,334	127,086	120,962	119,669	120,909	118,678	115,393	118,332	118,419	116,725	117,364	115,941	101,379	120,408

B. Photovoltaic Power Produced Locally (by FY)

	FY13	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	2013-23 Average
Jul		178	91	78	60	65	65	63	57	*63*	*63*	*63*	78
Aug		139	126	93	37	67	67	73	61	*73*	*73*	*73*	81
Sep		90	105	71	134	82	75	109	86	*109*	*109*	*109*	97
Oct		168	139	61	148	93	41	134	70	*134*	*134*	*134*	112
Nov		107	131	62	115	61	49	82	49	*82*	*82*	*82*	82
Dec		64	94	39	99	51	6	56	38	*56*	*56*	*56*	56
Jan	112	118	87	55	58	64	*-115*	68	*37*	*68*	*68*	*68*	56
Feb	123	115	87	41	122	61	43	86	44	*86*	*86*	*86*	81
Mar	172	167	121	143	158	94	67	58	63	*58*	*58*	*58*	106
Apr	120	149	125	112	143	103	78	75	82	*75*	*75*	*75*	103
May	164	145	108	114	150	96	75	78	*78*	*78*	*78*	*78*	106
Jun	147	156	96	105	137	83	73	71	*71*	*71*	*71*	*71*	98
FY Total		1598	1309	973	1362	921	525	953	734	*953*	*953*	*953*	1,028

C. Electric Power Used (by CY)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2011-23 Average
Jan	10,000	10,702	10,368	10,449	10,899	11,213	11,123	10,400	11,658	11,688	11,439	11,568	11,389	12,138	11,433	11,355	11,583	11,179	10,721	11,272	11,126	11,185	11,016	11,299	11,588	11,328
Feb	9,923	10,111	9,307	9,458	10,540	9,789	9,778	9,005	10,171	9,201	10,014	10,451	10,476	10,291	9,600	9,693	10,086	9,275	9,225	9,850	9,975	9,724	10,149	9,844	9,949	9,895
Mar	8,966	8,970	9,913	9,790	10,387	10,387	10,450	10,256	10,013	9,395	10,063	10,006	10,516	10,367	9,974	9,924	9,772	9,568	8,920	9,818	9,489	9,738	9,853	10,126	9,694	9,852
Apr	9,630	9,776	9,307	9,171	9,567	10,497	9,656	9,479	9,180	9,154	8,994	9,440	9,476	9,611	9,383	8,993	9,231	8,992	8,046	8,711	8,528	8,649	8,729	8,522	8,814	8,947
May	8,030	8,442	10,183	9,583	10,344	10,898	10,426	9,810	9,597	9,017	9,366	9,585	10,265	10,188	9,833	9,064	9,273	8,749	8,712	8,908	9,089	8,937	9,296	8,671		9,275
Jun	9,209	9,501	9,248	9,771	10,898	10,963	10,545	10,103	9,931	8,660	10,322	10,476	11,714	11,058	10,402	10,003	10,592	10,594	10,886	9,267	9,797	10,190	10,091	9,035		10,316
Jul	9,444	9,699	10,515	11,254	10,962	12,133	10,983	10,833	10,468	10,451	10,555	11,655	11,684	10,617	11,086	10,128	11,882	11,168	11,168	10,787	10,798	10,474	10,701	12,301		11,112
Aug	8,497	10,517	10,794	10,495	10,326	11,004	10,378	11,292	10,308	10,312	10,184	11,387	11,549	10,613	10,242	10,670	9,947	10,275	10,275	10,952	10,449	10,564	9,970	10,838		10,595
Sep	9,499	8,263	9,195	9,792	9,863	10,126	9,521	9,409	9,395	8,151	10,145	9,560	9,914	9,503	9,853	8,996	9,455	9,344	9,141	9,580	8,287	9,520	9,212	9,176		9,349
Oct	9,315	9,602	9,341	10,051	9,696	9,757	10,022	9,597	9,273	9,509	9,450	9,679	9,694	9,501	9,377	9,537	9,348	8,987	9,505	9,131	8,730	8,767	9,043	8,818		9,240
Nov	8,751	10,008	9,693	10,128	10,202	10,063	10,086	9,722	9,622	9,683	10,070	10,176	9,913	10,100	10,059	10,333	9,762	9,290	9,882	9,887	9,421	9,130	9,481	9,799		9,787
Dec	9,379	10,244	10,777	11,553	11,358	11,400	11,596	11,306	11,808	11,691	11,199	12,039	11,517	11,601	11,328	11,682	11,290	10,740	11,060	11,030	11,352	10,729	10,989	11,205		11,274
CY Tot.	110,643	115,834	118,642	121,495	125,041	128,230	124,563	121,213	121,424	116,911	121,800	126,023	128,106	125,587	122,570	120,379	122,220	118,160	117,542	119,194	117,040	117,607	118,530	119,634	40,046	120,969

Table A2.1.2. HEATING DEGREE DAYS PER MONTH

(from LANL Weather Machine)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2011-23 Average
Jan	963	1,205	1,091	861	1,068	961	990	1,233	1,281	1,032	1158	1117	1004	1225	1016	1018	1093	1072	951	1162	1085	1092	1056	1111	1067	1,077
Feb	794	905	942	910	1,115	879	822	930	940	783	1056	993	960	960	772	796	769	724	790	992	932	921	1006	921	827	887
Mar	780	809	821	795	636	876	790	663	780	741	868	619	639	695	748	591	641	569	722	765	701	779	761	861	767	699
Apr	462	486	369	525	599	549	411	555	550	564	543	480	397	501	554	466	512	504	402	476	440	480	427	523	467	474
May	166	196	206	232	195	281	157	320	328	201	314	340	173	260	310	366	312	301	116	416	127	214	174	230	252	257
Jun	17	36	14	52	55	62	18	61	94	112	18	8	1	10	18	19	9	18	16	71	24	59	39	95	13	30
Jul	1	0	1	0	30	1	15	0	9	14	12	0	2	17	12	16	1	0	1	5	0	3	2	0		5
Aug	11	29	8	25	49	53	11	2	40	25	16	0	2	12	34	1	75	18	2	0	0	2	29	0		13
Sep	85	79	182	125	190	105	289	135	135	200	41	158	133	173	66	18	115	99	78	57	161	71	42	102		98
Oct	544	399	545	340	533	499	516	408	448	571	421	478	383	549	340	358	285	449	511	554	352	446	499	357		428
Nov	1,031	741	845	819	873	710	739	699	736	698	841	793	671	840	781	774	713	559	842	805	684	604	883	724		744
Dec	1,076	1,112	1,144	1,059	1,085	1,032	1,110	1,161	1,097	1,273	934	1,198	1,109	1,106	1,002	1,049	1,016	892	1,081	1,053	1,076	915	999	992		1,038
Total	5,930	5,997	6,168	5,743	6,428	6,008	5,868	6,167	6,438	6,214	6,222	6,184	5,474	6,348	5,653	5,472	5,541	5,205	5,512	6,356	5,582	5,586	5,917	5,916	3,393	5,750

Table A2.2.2. RENEWABLE ENERGY SUPPLY IN ECA

(MWh)

Calendar Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2011-23 Average
Source																									
Total Hydro	220,310	140,599	140,212	125,876	128,410	130,688	137,073	130,798	181,824	160,147	151,861	181,816	148,010	126,348	100,032	88,825	74,976	147,308	105,015	153,317	110,587	103,048	78,605	107,571	117,343
El Vado	34,600	22,686	20,780	17,877	21,894	21,676	25,858	27,413	43,333	37,197	36,022	32,524	27,200	14,429	43	0	0	18,194	1,598	33,062	13,947	8,285	3,092	1,525	11,838
Abiquiu	49,115	22,465	36,721	17,218	20,766	32,272	27,003	25,102	51,487	47,290	40,761	38,075	43,250	26,034	24,904	13,740	0	50,851	28,382	45,170	21,555	19,695	22,090	46,475	29,248
WAPA (LAC)	6,811	4,802	5,353	6,062	5,032	4,727	4,826	4,928	5,388	5,127	5,090	7,411	5,288	5,097	5,097	5,097	4,982	5,255	5,092	5,097	5,097	5,095	3,535	3,889	5,079
WAPA (DOE)	92,303	84,208	71,166	84,719	80,718	72,013	79,386	73,355	81,616	70,533	69,988	103,806	72,272	80,788	69,988	69,988	69,994	73,008	69,943	69,988	69,988	69,973	49,888	55,682	71,177
WAPA (Peaking)	37,481	6,438	6,192	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0				0
Total CH (largely coal)	292,595	369,222	386,895	416,137	371,841	451,346	435,604	370,963	348,640	386,860	398,728	393,046	429,862	433,220	411,144	457,778	511,303	440,218	479,378	411,678	417,280	376025	424,129	382,863	428,302
Total Supply	512,905	509,821	527,107	542,013	500,251	582,034	572,677	501,761	530,464	547,007	550,589	574,862	577,872	559,568	511,176	546,603	586,279	587,526	584,393	564,994	527,868	479,073	502,734	490,434	545,645
% Hydro	43.0%	27.6%	26.6%	23.2%	25.7%	22.5%	23.9%	26.1%	34.3%	29.3%	27.6%	31.6%	25.6%	22.6%	19.6%	16.3%	12.8%	25.1%	18.0%	27.1%	20.9%	21.5%	15.6%	21.9%	21.4%
% CH	57.0%	72.4%	73.4%	76.8%	74.3%	77.5%	76.1%	73.9%	65.7%	70.7%	72.4%	68.4%	74.4%	77.4%	80.4%	83.7%	87.2%	74.9%	82.0%	72.9%	79.1%	78.5%	84.4%	78.1%	78.6%

Table A2.3. PETROLEUM FUELS USE
(1000's of gallons)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2011-23 Average
A. Taxable Gasoline (from NM Tax & Rev. Dept. data)																					
Jan	*821*	*48*	435	458	516	414	454	394	413	492	475	425	440	553	411	417	229	200	395	531	408
Feb	*162*	*1,048*	409	383	336	381	390	410	382	437	449	415	404	467	378	371	220	178	406	505	377
Mar	*1,117*	*223*	445	424	415	427	420	412	430	476	440	471	497	528	489	334	205	171	477	518	411
Apr	*649*	*193*	431	402	401	386	369	377	*490*	428	417	469	492	465	467	170	220	209	464	479	387
May	*545*	*581*	477	409	421	469	431	440	*506*	486	522	475	498	502	485	309	260	311	498	458	440
Jun	*689*	*542*	463	395	429	454	379	378	*491*	482	487	457	470	467	436	422	305	318	542		433
Jul	*653*	508	456	406	427	456	398	367	*466*	495	505	472	508	456	465	426	217	278	454		423
Aug	*672*	452	532	390	443	505	452	396	456	526	464	472	516	530	471	392	240	304	520		442
Sep	*595*	412	428	382	426	426	419	349	411	461	418	446	463	464	435	439	226	310	501		411
Oct	*696*	458	468	420	435	416	423	434	515	480	463	449	470	475	480	435	239	330	471		436
Nov	*566*	427	436	363	360	433	398	407	460	414	396	424	437	405	424	211	248	353	449		387
Dec	*762*	423	465	369	393	399	420	396	479	445	422	455	425	404	466	229	225	383	415		397
Ann. Total	7,928	5,315	5,444	4,802	5,001	5,168	4,954	4,760	5,499	5,622	5,457	5,430	5,620	5,717	5,406	4,155	2,833	3,345	5,592	2,491	4,953
C. County & Schools Fuel																					
Jan		20	19	24	24	27	42	21	36	33	33	28	44	28	38	21	6	23	25		29
Feb		20	19	24	24	27	29	37	21	35	35	37	21	29	37	29	17	25	23		29
Mar		20	19	24	24	27	35	37	36	35	35	36	43	37	29	27	23	27	27		33
Apr		20	19	24	24	27	21	34	33	33	33	30	21	38	30	17	25	24	23		28
May		20	19	24	24	27	36	34	35	35	35	35	35	29	21	10	24	25	25		29
Jun		20	19	24	24	27	35	31	31	31	31	27	40	33	26	31	21	24	25		30
Jul	20	19	24	24	20	26	21	28	30	30	34	34	17	26	28	18	24	25	27		26
Aug	20	19	24	24	20	28	34	49	34	32	26	27	35	36	43	18	27	30	29		32
Sep	20	19	24	24	20	27	35	35	36	33	37	44	36	28	29	19	25	27	27		32
Oct	20	19	24	24	20	27	36	37	49	47	44	19	44	45	29	27	25	25	25		35
Nov	20	19	24	24	20	25	35	35	19	19	27	28	36	29	36	18	22	23	24		27
Dec	20	19	24	24	20	26	43	33	34	33	35	34	29	29	37	17	23	21	23		30
Ann. Total		235	261	290	265	319	401	410	394	395	406	380	400	388	384	251	261	300	303		360
D. Total Petroleum Fuel (incl. taxed and untaxed gasoline, diesel fuel, LAC, & LAPS fuels)																					
Jan		650	519	551	617	503	564	474	511	599	580	517	550	665	449	438	235	223	421	531	479
Feb		650	490	465	410	465	477	509	460	537	551	514	485	566	415	400	237	203	429	505	445
Mar		463	531	512	501	518	518	511	530	583	542	578	614	644	518	361	227	198	504	518	487
Apr		463	515	487	485	471	446	468	597	525	512	569	588	573	497	187	245	234	486	479	456
May		463	568	495	508	566	532	540	617	594	635	581	608	606	506	319	284	336	523	458	514
Jun		463	552	478	517	549	471	465	596	585	591	553	581	570	462	454	326	341	567		505
Jul		603	548	491	512	551	479	450	567	599	614	577	601	550	493	444	241	303	480		492
Aug		539	636	472	530	610	553	504	558	637	559	571	629	646	515	410	267	334	549		518
Sep		493	516	463	510	517	517	436	509	563	519	557	569	563	465	457	251	338	528		482
Oct		545	562	507	521	506	523	536	642	599	576	535	585	591	509	462	264	355	496		513
Nov		510	525	441	434	523	493	503	548	495	483	516	538	494	460	229	270	377	473		452
Dec		505	559	448	472	485	525	489	585	545	520	558	517	494	502	246	248	404	438		467
Ann. Total		6,347	6,522	5,812	6,017	6,263	6,099	5,885	6,719	6,860	6,682	6,625	6,864	6,962	5,790	4,406	3,094	3,645	5,895		5,810

Diesel Fuel — *10% of taxed gasoline sales*
Untaxed Gasoline (excl. LAC & LAPS) — *5% of taxed gasoline sales*
Total — *15% of taxed gasoline sales*

The average energy content of a gallon of gasoline is 124,000 BTU's or 1.31×10^{-4} TJ. The average energy content of a gallon of diesel fuel is 139,000 BTU's or 1.47×10^{-4} TJ.[7] The latter is about 15% of LA's total petroleum-based fuel, so a weighted average for petroleum fuels of 1.33×10^{-4} TJ gal^{-1} is used.

Energy use for each component in units of terajoules are shown in Table A2.4. Totals for all three primary forms of energy are given in Table A2.5.

Table A2.4. ENERGY COMPONENT USE

(TJ)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2011-23 Average
A. Natural Gas																									
Jan	159	184	164	139	161	150	155	185	194	152	176	164	148	189	157	155	166	147	152	171	170	167	161	168	163
Feb	129	136	141	138	159	134	124	138	136	117	147	151	136	143	112	120	118	105	119	145	142	136	153	141	132
Mar	117	120	117	115	92	134	108	98	109	102	124	92	93	98	100	88	92	81	103	113	101	113	108	126	101
Apr	66	72	57	42	83	76	56	73	70	75	74	61	53	65	75	63	68	64	50	67	60	62	57	71	63
May	28	38	40	41	34	43	30	47	43	33	46	48	31	37	47	52	40	40	30	54	27	32	31	33	38
Jun	28	28	25	29	21	22	21	24	21	26	25	23	16	20	24	30	19	21	23	25	21	22	22	23	22
Jul	26	29	24	23	20	19	19	20	20	21	23	23	16	20	21	22	20	19	21	20	19	21	21	19	20
Aug	29	28	27	26	21	21	21	21	23	21	24	21	17	21	22	22	22	21	21	20	19	22	24	20	21
Sep	36	29	29	28	27	23	33	24	28	31	24	26	23	30	31	22	24	28	23	21	30	25	22	21	25
Oct	84	58	72	47	72	62	68	54	56	72	73	60	50	71	49	51	40	61	70	75	53	62	63	42	57
Nov	156	99	130	115	132	106	108	98	102	104	105	115	97	120	116	116	93	86	125	121	95	89	94	89	104
Dec	170	167	175	154	169	158	167	170	153	188	135	173	160	166	150	159	140	141	163	164	149	143	162	136	154
CY Tot.	1,028	988	1,001	896	990	947	909	952	955	941	977	956	840	979	903	900	840	815	902	997	885	894	918	889	901
B. Electricity																									
Jan	36	39	37	38	39	40	40	37	42	42	41	42	41	44	41	41	42	40	39	41	40	40	40	41	41
Feb	36	36	34	34	38	35	35	32	37	33	36	38	38	37	35	35	36	33	33	35	36	35	37	35	36
Mar	32	32	36	35	37	37	38	37	36	34	36	36	38	37	36	36	35	34	32	35	34	35	35	36	35
Apr	35	35	34	33	34	38	35	34	33	33	32	34	34	35	34	32	33	32	29	31	31	31	31	31	32
May	29	30	37	34	37	39	38	35	35	32	34	35	37	37	35	33	33	31	31	32	33	32	33	31	33
Jun	33	34	33	35	39	39	38	36	36	31	37	38	42	40	37	36	38	38	39	33	35	37	36	33	37
Jul	34	35	38	41	39	44	40	39	38	38	38	42	42	38	40	36	43	40	40	39	39	38	39	44	40
Aug	31	38	39	38	37	40	37	41	37	37	37	41	42	38	37	38	36	37	37	39	38	38	36	39	38
Sep	34	30	33	35	36	36	34	34	34	29	37	34	36	34	35	32	34	34	33	34	30	34	33	33	34
Oct	34	35	34	36	35	35	36	35	33	34	34	35	35	34	34	34	34	32	34	33	31	32	33	32	33
Nov	32	36	35	36	37	36	36	35	35	35	36	37	36	36	36	37	35	33	36	36	34	33	34	35	35
Dec	34	37	39	42	41	41	42	41	43	42	40	43	41	42	41	42	41	39	40	40	41	39	40	40	41
CY Tot.	398	417	427	437	450	462	448	436	437	421	438	454	461	452	441	433	440	425	423	429	421	423	427	431	435
C. Petroleum Fuels																									
Jan							86	69	73	82	67	75	63	68	80	77	69	73	88	60	58	31	30	56	64
Feb							86	65	62	55	62	63	68	61	71	73	68	64	75	55	53	32	27	57	59
Mar							62	71	68	67	69	69	68	71	77	72	77	82	86	69	48	30	26	67	65
Apr							62	68	65	65	63	59	62	79	70	68	76	78	76	66	25	33	31	65	61
May							62	76	66	68	75	71	72	82	79	84	77	81	81	67	42	38	45	70	68
Jun							62	73	64	69	73	63	62	79	78	79	73	77	76	61	60	43	45	75	67
Jul							80	73	65	68	73	64	60	75	80	82	77	80	73	66	59	32	40	64	65
Aug							72	85	63	70	81	74	67	74	85	74	76	84	86	68	55	36	44	73	69
Sep							66	69	62	68	69	69	58	68	75	69	74	76	75	62	61	33	45	70	64
Oct							73	75	67	69	67	69	71	85	80	77	71	78	79	68	61	35	47	66	68
Nov							68	70	59	58	70	66	67	73	66	64	69	72	66	61	31	36	50	63	60
Dec							67	74	60	63	65	70	65	78	73	69	74	69	66	67	33	33	54	58	62
CY Tot.							844	867	773	800	833	811	783	894	912	889	881	913	926	770	586	412	485	784	773
Total Energy U							**2,202**	**2,256**	**2,165**	**2,162**	**2,248**	**2,221**	**2,084**	**2,325**	**2,257**	**2,222**	**2,162**	**2,153**	**2,251**	**2,196**	**1,892**	**1,729**	**1,830**	**2,104**	2,110

Natural gas: *1.06E-04 TJ therm^{-1}*
Electricity: *3.60E-03 TJ MWH^{-1}*
Motor Fuel: *1.33E-04 TJ gal^{-1}*

Table A2.5. TOTAL ENERGY USE IN LOS ALAMOS COUNTY (excluding LANL) (TJ)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2011-23 Average
Jan	282	291	309	276	284	280	252	300	278	273	276	260	279	272	268	239	230	264	267
Feb	246	235	235	204	245	252	242	241	218	229	222	203	227	236	232	202	216	234	227
Mar	207	205	213	202	229	197	199	205	213	196	204	197	221	217	183	178	170	230	201
Apr	152	175	167	172	169	154	149	179	178	163	177	175	155	165	115	125	119	167	156
May	129	158	144	133	155	153	139	156	161	169	150	152	142	153	102	102	109	133	140
Jun	120	133	121	126	135	124	120	139	139	144	131	136	138	120	117	102	104	131	126
Jul	139	132	123	127	134	128	118	134	140	140	139	139	135	125	117	91	100	128	126
Aug	130	147	123	129	142	136	125	133	144	135	134	142	144	128	111	96	104	132	128
Sep	133	127	123	128	129	129	117	131	142	124	132	137	131	118	121	92	100	125	123
Oct	177	164	157	176	174	164	157	191	162	162	145	171	183	175	146	129	143	140	159
Nov	212	203	195	197	211	217	199	229	218	217	196	191	226	218	159	158	178	187	200
Dec	276	285	255	293	240	287	267	285	264	271	255	249	268	270	222	215	255	234	257
Ann. Total	**2,202**	**2,256**	**2,165**	**2,162**	**2,248**	**2,221**	**2,084**	**2,325**	**2,257**	**2,222**	**2,162**	**2,153**	**2,251**	**2,196**	**1,892**	**1,729**	**1,830**	**2,104**	**2,110**

A3 Carbon Dioxide Emissions Associated with Hydrocarbon Combustion

A3.1 Natural Gas

Carbon dioxide production associated with burning of natural gas produces nominally 117 lbs of CO_2 per MBTU (million BTU's) of energy produced.[8] This is equivalent to 50 mt TJ^{-1}.

Natural gas is comprised largely of methane, CH_4, also a significant greenhouse gas. It has far more global warming effect (per unit mass) than CO_2, but breaks down more rapidly in the atmosphere. Over 100 years, CH_4 has approximately 28 times the global warming potential of CO_2. (Over the first 20 years, the global warming potential is approximately 84 times that of CO_2.) Nationwide, more than 2% of natural gas produced leaks into the atmosphere from production, storage, transmission, and distribution systems.

Leak measurements are controversial and uncertainties substantial. Most of LA's natural gas comes from the Permian Basin, one of the leakiest well fields in the country. Aerial and satellite surveys showed leak rates of 3-9% over the period 2010-2019[17] and 9.4 ± 3.4 % in 2019.[18] For this work, a conservative and convenient total leakage rate (well field, transmission, and end use) estimate of 3.6% is used. With this value, the CO_2 equivalent global warming contribution from CH_4 leakage is also 50 mt TJ^{-1} and the total for natural gas 100 mt TJ^{-1}. Actual values are likely higher.

CO_2-equivalent emissions from the community's use of natural gas are summarized in Table 3.4A.

A3.2 Electricity

In New Mexico, approximately 986 lbs. of CO_2 is emitted from coal-fired power plants for each megawatt-hour of electricity produced.[16] This is equivalent to 125 mt TJ^{-1}. This value has varied slightly over the years, but is used for all years in this document. In recent years, natural gas has replaced coal for an increasing fraction of CH-based generation. As discussed in A3.1 above, even with a conservative estimate of CH_4 leakage, the CO_2-equivalent emissions from natural gas are comparable to those from coal. Along with the uncertainties in the coal-gas mix in purchased electrical power, there is no solid basis to use any total CO_2e emission factor any different from that of coal-based generation.

Table A3.4. CARBON DIOXIDE-EQUIVALENT COMPONENT PRODUCTION

(Metric tons; 1 mt = 1000 kg)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2011-23 Average
A. Natural Gas																									
Jan	15,858	18,450	16,377	13,941	16,097	15,029	15,513	18,470	19,373	15,159	17,597	16,356	14,802	18,862	15,688	15,460	16,564	14,665	15,242	17,147	17,007	16,711	16,066	16,780	16,258
Feb	12,921	13,631	14,061	13,817	15,864	13,417	12,422	13,770	13,640	11,654	14,697	15,136	13,641	14,304	11,211	12,046	11,782	10,505	11,857	14,507	14,249	13,550	15,268	14,096	13,242
Mar	11,735	11,951	11,668	11,525	9,244	13,403	10,817	9,791	10,879	10,153	12,412	9,200	9,349	9,752	10,009	8,777	9,189	8,113	10,346	11,251	10,094	11,299	10,809	12,616	10,062
Apr	6,588	7,217	5,689	4,195	8,282	7,555	5,551	7,254	6,957	7,466	7,427	6,104	5,286	6,493	7,465	6,283	6,769	6,428	5,026	6,728	5,963	6,161	5,688	7,127	6,271
May	2,808	3,830	4,046	4,117	3,354	4,277	2,958	4,707	4,334	3,281	4,642	4,796	3,054	3,740	4,651	5,212	3,961	3,999	3,010	5,383	2,676	3,154	3,133	3,253	3,848
Jun	2,784	2,827	2,532	2,856	2,076	2,195	2,091	2,365	2,146	2,635	2,470	2,313	1,571	1,981	2,370	2,963	1,891	2,100	2,330	2,477	2,095	2,238	2,231	2,279	2,218
Jul	2,579	2,851	2,431	2,253	1,990	1,918	1,924	2,036	1,981	2,126	2,313	2,258	1,592	2,031	2,094	2,230	1,998	1,909	2,144	2,025	1,870	2,149	2,149	1,949	2,031
Aug	2,883	2,779	2,708	2,593	2,113	2,106	2,083	2,133	2,280	2,112	2,377	2,106	1,672	2,086	2,228	2,213	2,209	2,097	2,118	2,028	1,897	2,231	2,405	2,024	2,101
Sep	3,592	2,925	2,874	2,778	2,707	2,254	3,330	2,437	2,764	3,090	2,400	2,595	2,318	2,963	3,149	2,228	2,385	2,772	2,290	2,131	2,994	2,458	2,230	2,129	2,511
Oct	8,435	5,781	7,161	4,706	7,236	6,185	6,791	5,442	5,615	7,212	7,289	5,962	5,037	7,139	4,889	5,091	4,018	6,117	6,992	7,492	5,282	6,229	6,280	4,218	5,750
Nov	15,552	9,897	13,013	11,491	13,152	10,597	10,768	9,792	10,179	10,401	10,543	11,464	9,679	11,998	11,567	11,591	9,257	8,625	12,512	12,143	9,482	8,930	9,361	8,858	10,421
Dec	17,043	16,680	17,493	15,361	16,935	15,811	16,666	17,006	15,316	18,800	13,499	17,334	16,025	16,588	15,027	15,940	14,023	14,149	16,294	16,383	14,859	14,307	16,200	13,563	15,438
Total	102,778	98,818	100,051	89,633	99,049	94,749	90,915	95,204	95,463	94,089	97,664	95,624	84,025	97,938	90,348	90,034	84,045	81,478	90,160	99,696	88,468	89,417	91,820	88,894	90,150
B. Electricity																									
Jan	2,567	3,488	3,425	3,610	3,646	3,913	3,807	3,460	3,448	3,720	3,728	3,559	3,812	4,229	4,138	4,280	4,546	3,769	3,958	3,696	3,958	3,951	4,182	3,969	4,004
Feb	2,547	3,295	3,074	3,268	3,525	3,416	3,347	2,996	3,008	2,928	3,263	3,216	3,507	3,585	3,475	3,653	3,958	3,127	3,405	3,230	3,549	3,435	3,853	3,458	3,496
Mar	2,302	2,923	3,274	3,382	3,474	3,625	3,577	3,412	2,961	2,990	3,279	3,078	3,520	3,612	3,610	3,740	3,835	3,226	3,293	3,219	3,375	3,439	3,740	3,557	3,480
Apr	2,472	3,186	3,074	3,168	3,200	3,663	3,305	3,154	2,715	2,913	2,931	2,904	3,172	3,348	3,396	3,389	3,623	3,032	2,970	2,856	3,034	3,055	3,314	2,994	3,161
May	2,061	2,751	3,363	3,311	3,460	3,803	3,569	3,264	2,838	2,870	3,052	2,949	3,436	3,549	3,559	3,416	3,639	2,950	3,216	2,921	3,233	3,157	3,529	3,046	3,277
Jun	2,364	3,096	3,054	3,376	3,645	3,826	3,609	3,361	2,937	2,756	3,364	3,223	3,921	3,853	3,765	3,770	4,157	3,572	4,018	3,039	3,485	3,599	3,831	3,174	3,647
Jul	2,424	3,161	3,473	3,888	3,667	4,234	3,759	3,604	3,096	3,326	3,440	3,586	3,911	3,699	4,013	3,817	4,663	3,766	4,122	3,537	3,841	3,700	4,062	4,321	3,926
Aug	2,181	3,427	3,565	3,626	3,454	3,840	3,552	3,757	3,049	3,282	3,319	3,504	3,866	3,697	3,707	4,021	3,904	3,464	3,793	3,591	3,717	3,731	3,785	3,807	3,737
Sep	2,438	2,693	3,037	3,383	3,299	3,534	3,259	3,130	2,779	2,594	3,306	2,941	3,319	3,311	3,566	3,390	3,710	3,151	3,374	3,141	2,948	3,362	3,497	3,224	3,303
Oct	2,391	3,129	3,085	3,473	3,243	3,405	3,430	3,193	2,743	3,026	3,080	2,978	3,245	3,310	3,394	3,594	3,669	3,030	3,509	2,994	3,105	3,097	3,433	3,098	3,266
Nov	2,246	3,261	3,202	3,499	3,412	3,511	3,452	3,234	2,846	3,082	3,282	3,131	3,318	3,519	3,641	3,894	3,831	3,132	3,648	3,242	3,351	3,225	3,599	3,442	3,460
Dec	2,408	3,339	3,560	3,991	3,799	3,978	3,969	3,761	3,492	3,721	3,649	3,704	3,855	4,042	4,100	4,403	4,431	3,621	4,082	3,617	4,038	3,789	4,172	3,936	3,984
Total	28,403	37,750	39,187	41,976	41,825	44,747	42,637	40,327	35,912	37,207	39,693	38,774	42,883	43,754	44,363	45,368	47,966	39,840	43,389	39,082	41,634	41,539	44,999	42,027	42,740
%CH	57.0%	72.4%	73.4%	76.8%	74.3%	77.5%	76.1%	73.9%	65.7%	70.7%	72.4%	68.4%	74.4%	77.4%	80.4%	83.7%	87.2%	74.9%	82.0%	72.9%	79.1%	78.5%	84.4%	78.1%	78.6%
C. Petroleum Fuels																									
Jan							5,795	4,627	4,914	5,499	4,485	5,027	4,224	4,552	5,334	5,166	4,606	4,898	5,922	4,000	3,904	2,097	1,991	3,749	4,267
Feb							5,795	4,365	4,140	3,653	4,146	4,250	4,538	4,098	4,781	4,914	4,578	4,320	5,046	3,700	3,561	2,113	1,806	3,827	3,964
Mar							4,124	4,730	4,565	4,466	4,614	4,616	4,553	4,727	5,191	4,826	5,149	5,475	5,737	4,617	3,213	2,025	1,762	4,490	4,337
Apr							4,124	4,589	4,340	4,324	4,195	3,973	4,166	5,315	4,681	4,565	5,074	5,238	5,107	4,425	1,666	2,179	2,081	4,335	4,062
May							4,124	5,062	4,412	4,524	5,040	4,737	4,816	5,494	5,297	5,661	5,177	5,414	5,403	4,508	2,839	2,533	2,990	4,662	4,579
Jun							4,124	4,918	4,260	4,608	4,891	4,200	4,147	5,310	5,210	5,263	4,924	5,173	5,075	4,117	4,041	2,903	3,041	5,052	4,497
Jul							5,372	4,886	4,378	4,559	4,909	4,267	4,007	5,050	5,336	5,475	5,139	5,356	4,901	4,393	3,953	2,145	2,699	4,282	4,385
Aug							4,802	5,666	4,210	4,722	5,433	4,932	4,489	4,975	5,673	4,978	5,085	5,607	5,759	4,585	3,654	2,382	2,976	4,891	4,614
Sep							4,392	4,598	4,123	4,547	4,605	4,610	3,889	4,532	5,021	4,622	4,964	5,069	5,013	4,139	4,076	2,236	3,008	4,706	4,299
Oct							4,861	5,011	4,522	4,641	4,505	4,656	4,778	5,721	5,335	5,135	4,771	5,211	5,265	4,536	4,117	2,348	3,164	4,420	4,574
Nov							4,546	4,682	3,933	3,868	4,665	4,394	4,480	4,884	4,413	4,301	4,599	4,795	4,404	4,096	2,045	2,404	3,355	4,215	4,030
Dec							4,501	4,985	3,993	4,205	4,322	4,683	4,353	5,211	4,859	4,636	4,968	4,607	4,403	4,477	2,194	2,208	3,601	3,905	4,162
Total							56,559	58,117	51,789	53,615	55,808	54,344	52,441	59,870	61,132	59,543	59,035	61,162	62,036	51,592	39,262	27,572	32,476	52,533	51,769
Total							**190,111**	**193,648**	**183,164**	**184,912**	**193,164**	**188,742**	**179,348**	**201,562**	**195,842**	**194,944**	**191,046**	**182,481**	**195,585**	**190,370**	**169,365**	**158,529**	**169,295**	**183,454**	184,659

Natural gas 100 kg GJ^{-1} = mt TJ^{-1}
Electricity 125 kg GJ^{-1} = mt TJ^{-1}
Motor Fuel 67 kg GJ^{-1} = mt TJ^{-1}

For electricity, CO_2 emissions shown in Table A3.4B are derived by multiplying monthly electrical energy from Table A2.4B by each year's annual fraction of production from CH sources from Table A2.2.2 and then by the above emission factor. Because of the seasonal nature of electricity generation at hydroelectric plants, particularly El Vado and Abiquiu, the monthly fraction of electric power attributable to CH sources varies systematically. This variation is not recognized in these tables.

A3.3 Petroleum Fuels

Energy content of diesel fuel is about 12% more by volume than that of gasoline; carbon dioxide production is about 14% more. Since diesel is a small part of LA's total petroleum-based fuel consumption, the CO_2 emission factor is approximated as the same as gasoline, 67 mt TJ^{-1}. Emissions associated with all petroleum-based fuels are totaled in Table A3.4C.

A3.4 Total CH Fuel-based Carbon Dioxide-Equivalent Emissions

Total CO_2e production from all three forms of primary energy is totaled in Table A3.5, starting with 2006.

Table A3.5. TOTAL CARBON DIOXIDE-EQUIVALENT EMISSIONS FROM COMBUSTION OF HYDROCARBON FUELS IN LOS ALAMOS COUNTY (excluding LANL)
(Metric tons; 1 mt = 1000 kg)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2011-23 Average
Jan	25,116	26,557	27,734	24,378	25,809	24,942	22,839	27,643	25,160	24,906	25,716	23,332	25,122	24,844	24,869	22,759	22,239	24,499	24,528
Feb	21,564	21,131	20,788	18,236	22,106	22,601	21,685	21,987	19,467	20,613	20,319	17,952	20,308	21,436	21,358	19,098	20,928	21,381	20,703
Mar	18,518	17,933	18,405	17,609	20,306	16,894	17,422	18,091	18,810	17,343	18,173	16,814	19,376	19,087	16,682	16,763	16,312	20,663	17,879
Apr	12,980	14,997	14,011	14,704	14,553	12,981	12,624	15,157	15,542	14,237	15,466	14,698	13,103	14,010	10,663	11,395	11,083	14,456	13,493
May	10,650	13,032	11,584	10,674	12,733	12,482	11,306	12,784	13,507	14,289	12,777	12,363	11,629	12,812	8,748	8,844	9,652	10,961	11,704
Jun	9,824	10,644	9,344	9,999	10,724	9,736	9,639	11,144	11,344	11,996	10,971	10,846	11,423	9,633	9,622	8,740	9,102	10,505	10,362
Jul	11,056	10,526	9,455	10,011	10,661	10,111	9,510	10,779	11,442	11,522	11,800	11,031	11,168	9,954	9,664	7,993	8,911	10,552	10,341
Aug	10,437	11,556	9,539	10,115	11,129	10,541	10,027	10,759	11,609	11,212	11,198	11,168	11,669	10,204	9,268	8,344	9,166	10,722	10,453
Sep	10,981	10,166	9,665	10,231	10,311	10,146	9,526	10,805	11,736	10,240	11,059	10,991	10,678	9,412	10,018	8,057	8,736	10,059	10,113
Oct	15,082	13,646	12,879	14,880	14,873	13,596	13,060	16,170	13,618	13,821	12,458	14,358	15,766	15,021	12,504	11,674	12,877	11,736	13,589
Nov	18,767	17,708	16,957	17,350	18,489	18,989	17,478	20,401	19,621	19,786	17,687	16,552	20,564	19,481	14,878	14,558	16,316	16,515	17,910
Dec	25,137	25,752	22,801	26,726	21,470	25,721	24,233	25,841	23,986	24,978	23,422	22,377	24,780	24,477	21,091	20,305	23,973	21,404	23,584
Ann. Total	**190,111**	**193,648**	**183,164**	**184,912**	**193,164**	**188,742**	**179,348**	**201,562**	**195,842**	**194,944**	**191,046**	**182,481**	**195,585**	**190,370**	**169,365**	**158,529**	**169,295**	**183,454**	**184,659**

A4 Municipal Solid Waste

Over their lifetimes in a landfill, normal mixtures of MSW are estimated to emit about CH_4 equivalent to ~580 kg CO_2e ton^{-1}. Table A4 lists the amount of MSW attributed to the LA community and the CO_2e emissions from that MSW using that lifetime emission factor. The science of GHG emission from MSW is still evolving, so this emission factor should be regarded as very much a rough estimate subject to change.

Table A4. Solid Waste & CO_2e Emissions

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2010-19 Average
Total	55,001	49,884	57,686	54,393	35,709	27,804	22,236	26,155	27,066	23,312	23,771	22,070	18,380	18,226	16,895	15,995	16,072	15,165	16,464	17,483	17,498	17,417
LAC MSW	32,483	37,260	41,506	41,360	23,568	18,351	16,789	17,651	15,361	18,275	19,017	17,606	14,704	16,790	15,344	14,440	14,448	13,739	14,809	15,746	16,005	15,292
CO_2e	42,228	48,438	53,958	53,768	30,638	23,856	21,826	22,946	19,969	23,758	24,722	22,888	19,115	21,827	19,947	18,772	18,782	17,861	19,252	20,470	20,806	19,879

CO_2e = 1.30 mt/ton of Muni Solid Waste

Appendix B

from ↓ *to* →	btu	therm	W-hr	kWh	MWh	GWh	gal	bbl	J	kJ	MJ	GJ	TJ	PJ
btu	1	10^{-5}	0.293	2.93×10^{-4}	2.93×10^{-7}	2.93×10^{-10}	8.06×10^{-6}	1.7×10^{-7}	1,055	1.055	0.001055	1.055×10^{-6}	1.055×10^{-9}	1.055×10^{-12}
therm	10^{5}	1	2.93×10^{4}	29.3	0.0293	2.93×10^{-5}	0.806	0.017	1.055×10^{8}	1.055×10^{5}	105.5	0.1055	1.055×10^{-4}	1.055×10^{-7}
W-hr	3.41	3.41×10^{-5}	1	0.001	10^{-6}	10^{-9}	2.75×10^{-5}	5.88×10^{-7}	3,600	3.6	0.0036	3.6×10^{-6}	3.6×10^{-9}	3.6×10^{-12}
kWh	3,410	0.0341	1,000	1	0.001	10^{-6}	0.0275	5.88×10^{-4}	3.6×10^{6}	3,600	3.6	0.0036	3.6×10^{-6}	3.6×10^{-9}
MWh	3.41×10^{6}	34.1	10^{6}	1,000	1	0.001	27.5	0.588	3.6×10^{9}	3.6×10^{6}	3,600	3.6	0.0036	3.6×10^{-6}
GWh	3.41×10^{9}	3.41×10^{4}	10^{9}	10^{6}	1,000	1	2.75×10^{4}	588	3.6×10^{12}	3.6×10^{9}	3.6×10^{6}	3600	3.6	.0036
gallon (gal)	1.24×10^{5}	1.24	3.63×10^{4}	36.3	0.0363	3.63×10^{-5}	1	0.0214	1.31×10^{8}	1.31×10^{5}	131	0.131	1.31×10^{-4}	1.31×10^{-7}
barrel (bbl)	5.8×10^{6}	58	1.70×10^{6}	1,700	1.70	0.0017	46.7	1	6.12×10^{9}	6.12×10^{6}	6,120	6.12	0.00612	6.12×10^{-6}
J	9.48×10^{-4}	9.48×10^{-9}	2.78×10^{-4}	2.78×10^{-7}	2.78×10^{-10}	2.78×10^{-13}	7.63×10^{-9}	1.63×10^{-10}	1	0.001	10^{-6}	10^{-9}	10^{-12}	10^{-15}
kJ	0.948	9.48×10^{-6}	0.278	2.78×10^{-4}	2.78×10^{-7}	2.78×10^{-10}	7.63×10^{-6}	1.63×10^{-7}	1,000	1	0.001	10^{-6}	10^{-9}	10^{-12}
MJ	900.48	.00948	278	0.278	2.78×10^{-4}	2.78×10^{-7}	0.00763	1.63×10^{-4}	10^{6}	1,000	1	0.001	10^{-6}	10^{-9}
GJ	9.48×10^{5}	9.48	2.78×10^{5}	278	0.278	2.78×10^{-4}	7.63	0.163	10^{9}	10^{6}	1,000	1	0.001	10^{-6}
TJ	9.48×10^{8}	9,480	2.78×10^{8}	2.78×10^{5}	278	0.278	7,630	163	10^{12}	10^{9}	10^{6}	1,000	1	0.001
PJ	9.48×10^{11}	9.48×10^{6}	2.78×10^{11}	2.78×10^{8}	2.78×10^{5}	278	7.63×10^{6}	1.63×10^{5}	10^{15}	10^{12}	10^{9}	10^{6}	1,000	1

Table B-1 Conversion factors for various standard measures of energy.

To convert from a value expressed in units shown along the left side to a value in units shown along the top, multiply by the factor at the intersection of the row and column.

References

[1] Strategic Objective adopted by County Council, January 23, 2007

[2] "Powering Los Alamos Through the 21st Century: Could the Energy City be Energy Independent?" Energy Independent Los Alamos, unpublished.

[3] "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2009," R. B. Gibson, 7 April 2010. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2011," R. B. Gibson, 10 March 2012. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2012," R. B. Gibson, 7 March 2013. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2013," R. B. Gibson, 1 April 2014. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2014," R. B. Gibson, 22 May 2015. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2015," R. B. Gibson, 26 March 2016, "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2018," R. B. Gibson, 27 April 2019. "Historical Energy Use and Carbon Dioxide Emissions in Los Alamos County: 2000-2020," R. B. Gibson, 10 March 2021. All are unpublished but have been available on various websites.

[4] LAC DPU Utilities Consumption Reports for FY00-FY24, "Gas Rec'd, therms."

[5] LAC DPU Utilities Consumption Reports for FY00-FY24, "Power Rec'd, kwh."

[6] NM Tax & Revenue Dept., Private communication through CY 2017 and via IPRA request thereafter.

[7] http://www.eia.gov/energyexplained/index.cfm?page=about_energy_units

[8] http://www.eia.gov/oiaf/1605/coefficients.html

[9] https://www.epa.gov/gmi/importance-methane

[10] https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf , Table 9

[11] LANL Weather Machine, http://www.weather.lanl.gov/climo_monthly_summary.asp. (2003-Apr, 2017)

[12] LANL Environmental Data and Analysis Group, Private communication (2000-2002 and May, 2017-pres)

[13] LAC DPU Component Cost Summary Reports for CY00-23

[14] http://www.eia.doe.gov/oiaf/1605/ee-factors.html

[15] LA County Dept. of Public Works, Private communication

[16] LA Public Schools, Private communication

[17] Lu, X, et al, Proc. Natl. Acad. Sci. USA, **120** (17) 2217900120 (2023).

[18] Chen, Y., et al, Environ. Sci. Technol., **56**, 4317-4323 (2022).