Energy Efficiency and Renewable Energy Resources

Energy efficiency and renewable energy technologies should be important elements of a diverse energy portfolio for New Mexico. Energy efficiency can reduce the rate of growth in the state's energy demand, lower consumer utility bills, and strengthen local economies by freeing up dollars for other needed goods and services. Renewable energy technologies can contribute to supply diversification, help protect the environment, and provide a hedge against the price volatility of conventional fuels. Together, energy efficiency and renewable energy technologies have significant potential to enhance the energy security of New Mexico and our Nation.

Energy Efficiency

OVERVIEW

Energy efficiency technologies are cost-effective, commercially available, and are an important part of the solutions to our energy needs. These technologies can be implemented swiftly to address the current energy situation. Energy efficiency technologies generate savings from the date of installation through the useful life of the product. Since the tragic events of September 11, 2001, it has become all too apparent that our current system of energy supply is extremely brittle. Large central station power plants, oil and gas pipelines, and the electricity grid represent potential terrorist targets and are thus vulnerable to disruption. Energy efficiency cannot be destroyed by acts of war.

Energy efficiency is a demand-side energy resource. Sound energy policy recognizes that it is the equivalent of an energy resource readily available to virtually every consumer. The logic derives from the following equation: *1 barrel of oil saved = 1.4 barrels of oil earned.* The additional oil earned can be attributed to the fact that it takes energy to produce and deliver energy. Energy not used does not have to be produced and delivered.

Both energy efficiency and conservation are important resources to tap into in times of a crisis. However, they are distinctly different. Conservation is largely dependent on behavior. Consequently, it cannot be relied on for a long time. On the other hand, energy efficiency technologies can reliably save as much energy as many power plants produce.

- The cheapest megawatt is one that is not built.

- The least expensive kilowatt-hour or therm is one that is not used.

- Energy efficiency is the cheapest energy that money can buy.

- Energy conservation is the cheapest energy money cannot buy.

Perhaps the biggest and most costly myth in the business world is that energy represents a fixed operating cost. Fortune 500 companies in the energy service industry have made significant profits destroying the myth. Technology-driven energy savings are so predictable and reliable that banks routinely lend money for the purchase of these products, knowing that they will also profit from the energy savings. In New Mexico, energy service companies (ESCO) have implemented over $21 million of energy efficiency projects in public schools, saving over $3.5 million per year. These projects improved the learning environment for students and reduced the operating cost of schools for the taxpayer. Lenders now offer

energy efficiency mortgages and relax qualifying requirements based on the understanding that lower monthly energy bills increase homeowner disposable income and improve the probability of making mortgage payments.

- Energy efficiency is profitable and increases disposable income.

- Energy efficiency technologies empower users to control energy costs.

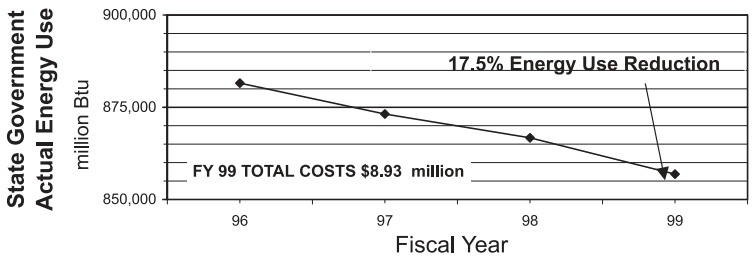
There are generally no regrets associated with implementing energy efficiency measures and renewable energy technologies. The corresponding economic and energy supply benefits are valuable in and of themselves, thereby supplementing the environmental attributes. Energy efficiency and renewable energy technologies are the best bet, especially over the long term.

ECMD PROGRAM ACCOMPLISHMENTS

The Energy Conservation and Management Division (ECMD) of the New Mexico Energy, Minerals and Natural Resources Department (EMNRD) has statutory responsibility for planning and implementing energy efficiency projects as well as those involving renewable or alternative energy resources. With respect to energy efficiency, ECMD focuses on identifying opportunities and applying Division resources to attain improvements in state, tribal, and local government facilities, public schools, institutions of higher learning and in private commercial buildings and residences throughout the state. In general, the greater the facility's energy consumption, the more promising the opportunity to minimize waste and improve efficiency. ECMD saves State agencies and public schools over $5 million per year through its energy efficiency and renewable energy programs—a cumulative total of over $25 million in the last five years alone, as indicated in Figure 1. The Division administers a number of other programs that also result in significant savings to the taxpayer; these programs, along with specific accomplishments in 2001 are discussed below. Additional information about our Division's activities can be obtained from the EMNRD-ECMD website, http://www.emnrd.state.nm.us.

Figure 1. ECMD-Managed Energy Programs Saved Over $25 Million in the Last Five Years

- **State Government**
  - Executive Orders #96-30 and #99-40 helped save $2.96 million in utility bills during the last five years.
- **Public Schools**
  - Technical reviews of Public School construction plans to ensure compliance with applicable energy codes saved $8.1 million in the last 5 years.
  - Technical review and certification of Public Facility Energy Efficiency and Water Conservation Act proposals saved $14.9 million in the last five years.



Energy Data from EMNRD-ECMD State Government Utility Bill Database

A few highlights of ECMD's Energy Efficiency initiative are as follows:

- Secured approximately $510,000 in federal [U.S. Department of Energy] grants for renewable energy, alternative transportation and energy efficiency projects in New Mexico. Projects include funding for purchase of compressed natural gas (CNG) shuttle buses for University of New Mexico ($200,000); Land of Enchantment Clean Cities Coordinator ($25,000); revision and update of building energy codes ($115,461); *Rebuild New Mexico* energy efficiency program ($150,000); and assessment of wind energy ($10,000) and distributed generation ($9,500) potential in New Mexico.

- Established and facilitated the activities of the New Mexico Sustainable Energy Collaborative (NMSEC). NMSEC's objective is the pursuit of cleaner, more efficient energy development and use through a cooperative, collaborative approach. Over 90 individuals, representing private businesses, universities, government, Indian tribes/pueblos, national laboratories, environmental groups, and trade organizations, are currently participating in NMSEC activities. In August 2000, the Collaborative filed

comments in response to the NM Public Regulation Commission's *Notice of Inquiry on Renewable Energy as a Source of Electricity.*

- Conducted public information, education and outreach activities on renewable energy, alternative transportation, and energy efficiency at UNM's *Earth Day Celebration* (April 2001); *Taos Solar Festival* (June 2001); *New Mexico State Fair*; the New Mexico Solar Energy Association's *Solar Fiesta* (September 2001); *Border Energy Forum VIII* (October 2001); and through direct technical assistance by phone, e-mail, and office visits.

State Government Energy Management Program. Under Governor Johnson's Executive Order #99-40, "Energy and Water Conservation in State Government," Cabinet-level State agencies are directed to reduce their energy consumption by 4% by June 30, 2002. This order directs State agencies to conserve energy and water through various mechanisms (e.g., development of energy saving plans; appointment of energy managers within each agency). As the lead agency tasked with implementation of this Executive Order on energy efficiency, ECMD provides technical and financial assistance in improving the energy performance of over 1,000 state-owned and operated buildings. Compliance is being facilitated by the *New Mexico Short-term Energy Conservation Strategy*, January 2001, which ECMD developed at the request of Governor Johnson in a cooperative effort with other western states to reduce energy usage.

Insulation, radiant heating, skylighting and efficient lighting - Highway Department Maintenance Building. Source: ECMD

A major function of ECMD has been to track and document State agencies' energy expenditures. To assist in this effort, the Division maintains a state utility bill database that contains nearly 1,700 gas and electric accounts. The data is provided by approximately 30 utility companies from across the state. Significantly, ECMD's utility database facilitates the timely reporting of energy usage and costs, thereby furnishing important feedback to State agencies in evaluating their compliance with Executive Order #99-40. **Energy consumption for Cabinet-level state agencies has been reduced by 17.5% based on the most currently available data from ECMD's tracking system.**

Of historical note, the New Mexico utility bill database was developed in 1993 by ECMD to implement the first State executive order on energy efficiency. It is one of the largest and longest running energy monitoring databases operating in the country. As a result of the experience gained with this database, ECMD recently provided technical assistance to the City of Albuquerque and the Albuquerque Public School District in setting up their own energy monitoring programs. Tracking of energy consumption trends will become even more important as electricity restructuring is implemented and the price of energy reflects more accurately how and when we use it.

Energy consumption within Cabinet-level State agency buildings in FY 1999 was reduced by 17.7% over the FY 1998 base year, exceeding the 4% saving goal established in the Order. Electricity and natural gas consumption dropped 6.2% and 17.5%, respectively; no adjustments have been made for weather and cost of fuel. These savings represent enough electricity to operate over 1,000 New Mexico homes for one year; and enough natural gas to annually heat the homes of over 1,800 New Mexicans. The electricity saved has reduced power plant emissions by 5,605 tons of carbon

dioxide, 16 tons of sulfur dioxide, and 18.2 tons of nitrogen oxides. The utility bills for 13 Cabinet-level departments during FY 1999 totaled $8.9 million ($7.35 million for electricity and $1.55 million for natural gas).

Several agencies have exceeded expectations in reducing energy consumption and costs. For example, the Health Department improved the efficiency of its facilities throughout the state with energy awareness, strict reporting, lighting improvements, and water conservation efforts—all without any funding from ECMD for energy efficiency retrofits. The Health Department, New Mexico's largest State agency, reduced in energy usage by 39.1% and was responsible for 53% of the total savings achieved under Executive Order #99-40. The Corrections Department also achieved a significant 28.3% energy savings. The Highway and Transportation Department implemented an efficiency program that created $5 of savings with every $1 provided by ECMD funding for energy retrofits. The Highway and Transportation Department leads all departments in total savings since the program was initiated in 1993. Over $230,000 in federal funds was used to purchase the energy efficiency, water conservation and solar photovoltaic (PV) equipment in New Mexico State Parks. These State Parks efforts helped EMNRD reduce its energy consumption by 7.1%.

Public School Construction Plans Review. ECMD reviewed 94 plans for new construction or renovation of New Mexico public schools totaling $139 million in construction costs during FY 2001 to ensure compliance with applicable energy codes and standards. These technical compliance reviews, conducted under an agreement with the State Department of Education, resulted in significant energy cost savings for taxpayers and in better, more comfortable learning environments for teachers and students. On average, application of these standards result in efficiency gains of 10%. However, the increased electricity consumption trend toward refrigerated air-conditioning over evaporative cooling that began in 2000 continues; the Alamogordo School District reported that their utility bills had doubled for one school facility where refrigerated air-conditioning was installed when compared to facilities using evaporative cooling. ECMD also continues to provide similar plan reviews for homebuilders, with over 69 builders and contractors being given direct technical assistance in filling out their energy code compliance forms.

The Public Facility Energy Efficiency and Water Conservation Act. ECMD provided support in amending the *Act* to make it easier for state agencies, counties and municipalities to enter into energy saving performance contracts; the amendments were included in House Bill 405. Since the *Act* was amended, ECMD has reviewed and approved a $2.3 million energy performance contract for Eastern New Mexico University (ENMU). ENMU will save $308,951 per year, representing a 33.7% reduction in annual energy expenditures. This latest contract is in addition to over $25 million in similar New Mexico energy performance projects that schools, universities, and local governments have implemented over the last 8 years. **These projects amount to taxpayer savings of more than $4.2 million per year.** Similarly, ECMD provided technical and administrative support of successful passage of Senate Memorial 15, urging cooperative efforts to increase energy efficiency and the use of renewable energy.

The *Act* also provides a mechanism for energy service companies (ESCOs) to determine the technical and economic feasibility of energy saving measures for government-owned facilities. A significant advantage of utilizing the Act's provisions is that State government agencies do not have to make up-front payments to ESCOs for installation of energy saving products and equipment; moreover, the estimated savings are guaranteed with a performance bond. ESCOs recover their costs from energy savings realized over a maximum period of 10 years. Any additional savings accrue to the contracting agency and ultimately to taxpayers. ECMD has statutory responsibility to review the proposed energy performance contracts and to work with agencies to get the best possible projects.

Rebuild America/Rebuild New Mexico Program. Over 59 businesses and government entities, with over 42.4 million square feet of building space, are participating as partners in this program to improve energy efficiency and reduce facility-operating costs. **Program energy**

audits have identified potential savings of more than $750,000 per year for 12 major *Rebuild* partners. Through the program, ECMD offers walk-thru audits, energy information and workshops, third-party review of energy proposals and other technical assistance. From 2000 to early 2001, ECMD also managed a *Rebuild New Mexico* project involving 31 at-risk youth in Albuquerque and at Taos Pueblo who were taught the basics of energy efficiency and how to implement low-cost efficiency measures. The students learned about energy issues and policy, as well as the technical aspects of lighting, heating, air-conditioning, ventilation and weatherization. The New Mexico Youth Conservation Corps program funded this innovative energy efficiency project.

Pollution Prevention Programs. ECMD provided for the training of approximately 80 oil and gas industry personnel on the Pollution Prevention Best Practices Manual developed with the EMNRD Oil Conservation Division. Other pollution prevention accomplishments included participation in the Green Zia Environmental Excellence Program, serving in the roles of examiner, judge and P^2 Advisory Council member; and continued funding to New Mexico State University for operation of the Pollution Prevention Technical Resource Center in Albuquerque. These programs provide technical assistance to governmental agencies, non-profit organizations, and businesses to improve solid waste management and encourage adoption of "best practices" in the areas of pollution prevention and energy efficiency.

Natural gas bus and alternative transportation - City of Santa Fe. Source: ECMD

Transportation Efficiency – Alternative Fuels. The goal of the ECMD Transportation Program is to reduce the use of petroleum-derived fuels and our dependence on imported oil. New Mexico's transportation sector accounts for over a third of all energy consumed in the state. In the last year we have seen our gasoline prices increase. In comparison to the fuel price paid by consumers in other countries, New Mexico's energy prices for transportation fuels such as gasoline and diesel still remain relatively low. Costs associated with delivery of transportation fuels such as military expenditures for maintaining our overseas oil supply lines are ultimately paid through taxes. New Mexico has been a leader in promoting energy efficiency in transportation since the 1970s when the Arab oil embargo and subsequent price increases prompted Congress to create the Department of Energy (DOE) and programs to reduce our country's dependence on foreign sources of oil by establishing federal and state partnership programs to promote energy efficiency. EMNRD administers the DOE State Energy Program that includes funding and promoting the use of alternative fuels in transportation.

Transportation strategies and federal regulations have guided efforts to increase the use of alternative fuels that include CNG, propane, E-85 (ethanol-gasoline blend), liquefied

Table 1. Acquisition of State Alternative Fuel Vehicles

Model Year Reported	Number of AFVs
2001	280
2000	111
1999	28
1998	56

natural gas (LNG), and electricity. Prompted by the federal Energy Policy Act (EPACT), New Mexico enacted legislation known as the Alternative Fuels Conversion Act and developed an energy policy goal to increase use of New Mexico's own energy resources in meeting state and federal mandates for reducing our dependence on foreign energy sources. With an aggressive approach starting in 1992, the state has consistently reported to DOE that it is in compliance with the current EPACT mandate that 75% of all state vehicles acquired be capable of operating on alternative fuels. The annual reporting to DOE of the number of alternative fuel vehicles (AFVs) purchased indicates that we are increasing acquisitions and are in an ideal position to maintain compliance status for the foreseeable future. One of the most successful alternative fuel projects funded by the Alternative Transportation Program is the University of New Mexico's (UNM) public access compressed natural gas station constructed on UNM's campus. This project was a model public-private partnership that brought the City of Albuquerque, Public Service Company of New Mexico (PNM), UNM and EMNRD to work together to make this project a success. The public access station is available for use by City of Albuquerque AFVs, state fleets and the UNM's Park & Ride shuttles. UNM has also acquired the newest CNG engine technology with the purchase of four John Deere CNG-powered buses that have proven alternative fuel technology's dependability. The convenience of the CNG station on campus and the effective operation of the new CNG buses have prompted UNM to request and apply for federal financial assistance to defray the incremental cost difference to purchase an additional five CNG buses for their fleet.

Table 2. Number of Transit Vehicles and CNG Used

Agency	Number of CNG Vehicles	CNG Gallons Used
Santa Fe Trails	31 buses	180,144
Suntran	40 buses	529,200
UNM Park & Ride Shuttle	14 buses	93.500
Espanola Public Transit	3 vans	8,528

Public transit agencies and park and ride programs in New Mexico are examining alternatives to conventional diesel buses. The City of Santa Fe (Santa Fe Trails), the City of Albuquerque (Suntran), the City of Espanola and UNM Park & Ride shuttles have successfully introduced clear alternatives, primarily CNG, into daily fleet operations. Through these efforts approximately 811,372 gallons of diesel fuel are displaced on an annual basis.

ECMD also provided funding and administrative assistance to the City of Las Cruces in the development of a publicly accessible CNG fueling station in that community. The Las Cruces CNG station is scheduled to be operational in early 2002. Additional assistance has been provided to the Belen, Los Lunas, and West Las Vegas school districts in converting their buses to CNG.

To assist transit agencies and community leaders, DOE has funded studies that confirm natural gas buses emit significantly fewer pollutants than their diesel counterparts. CNG buses are currently more expensive to purchase than diesel, but fuel cost comparisons show that natural gas is cheaper than gasoline and diesel. Natural gas offers applicability to future technologies, including hybrids and fuel cells because it can be used as a feedstock for hydrogen, a promising energy source for fuel cells. Investing in

Table 3. Transportation Program Projects, 2000-2001

Grantee	Purpose	Amount
University of New Mexico	Infrastructure - CNG public access fuel station	$ 75,000
	School bus deployment	$200,000
National Ethanol Vehicle Coalition	Infrastructure – E-85 public access fuel station	$100,000
City of Las Cruces	Infrastructure - CNG public access fuel station	$250,000
	Alternative fuel activities	$ 10,000
	Rideshare activities	$ 35,000
	Alternative fuel public outreach	$ 25,000
Belen Public School District	School bus engine re-powering	$135,000
West Las Vegas School District	School bus re-powering	$ 40,000
City of Albuquerque	Clean Cities Program Coordinator	$ 25,000
	Alternative fuel public outreach and alternative fuel demonstration	$ 50,000
Santa Fe Community College	Alternative fuel training statewide	$ 65,000

Figure 2. Alternative Fuels Infrastructure

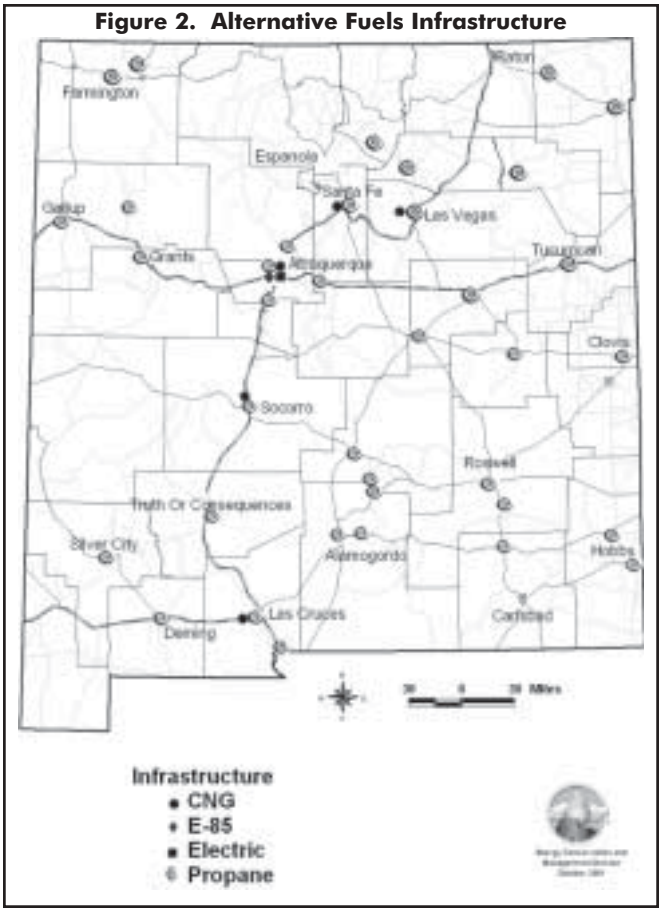
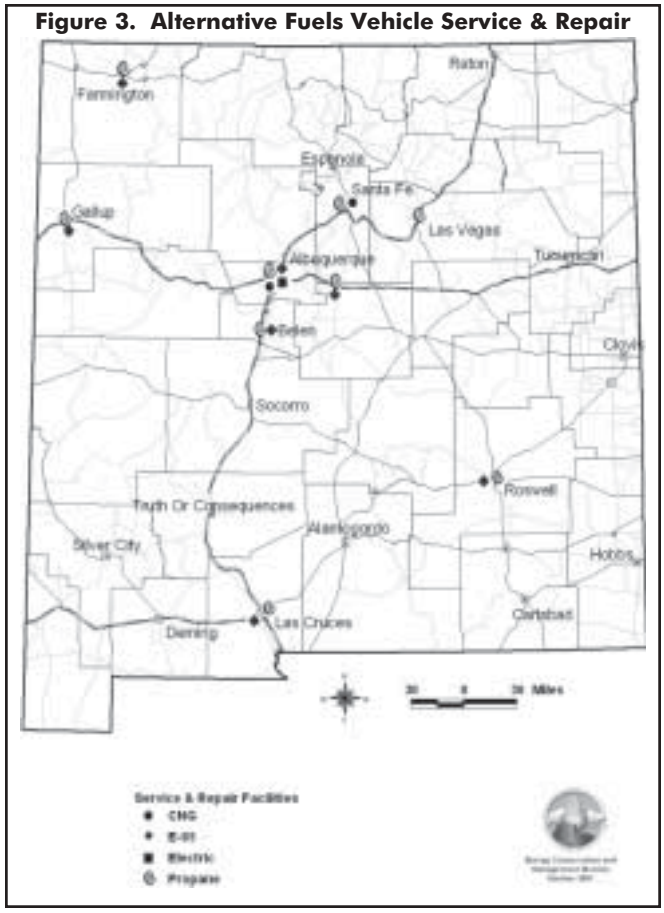


Figure 3. Alternative Fuels Vehicle Service & Repair



natural gas infrastructure can therefore pave the way to future transportation applications.

New Mexico is also home to many E-85 (flex-fuel) vehicles that are unable to use the alternative fuel until it becomes available. ECMD has selected the National Ethanol Vehicle Coalition to work with federal agencies, state agencies and the private sector to establish 5 to 7 public E-85 fueling sites including Albuquerque, Los Alamos and Santa Fe.

The ECMD Alternative Transportation Program in the last year has focused on assisting public transit agencies with their alternative fuel efforts and in developing New Mexico's CNG and E-85 alternative fuel infrastructure. ECMD has worked to encourage partnerships that enhance the program's goal, applied for federal Special Project funding to leverage support for planned projects, and continued to provide funding for alternative fuel training that is crucial to the understanding and continuing expansion of alternative fuel infrastructure.

New Mexico Maps showing alternative fuel infrastructure, vehicle service and repair, and station locations can be found in figures 2, 3, and 4, respectively.

Figure 4. Alternative Fuels Fleet Locations

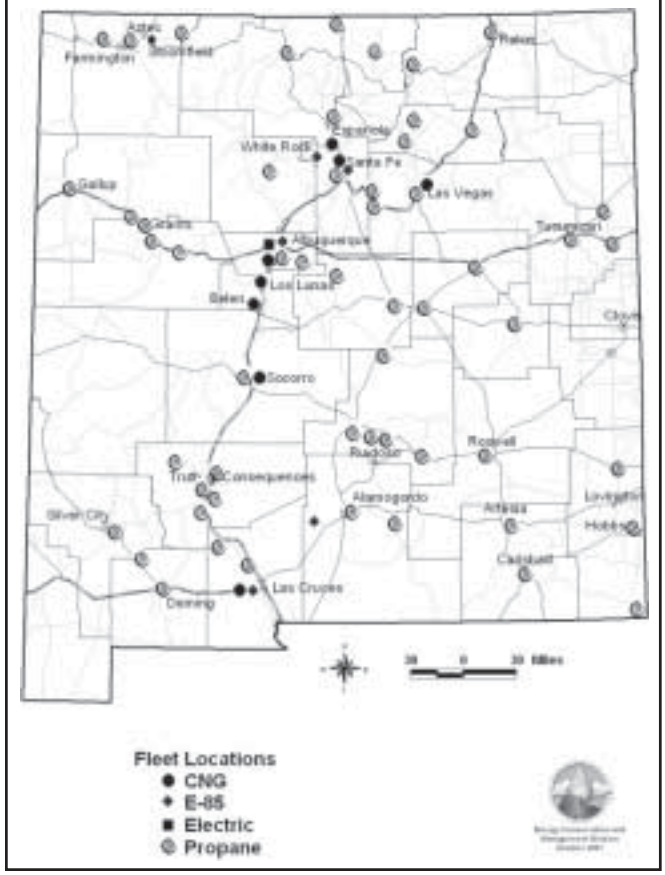


Figure 5. New Mexico Economic & Energy Squeeze: Annual Net Disposable Income Per Capita

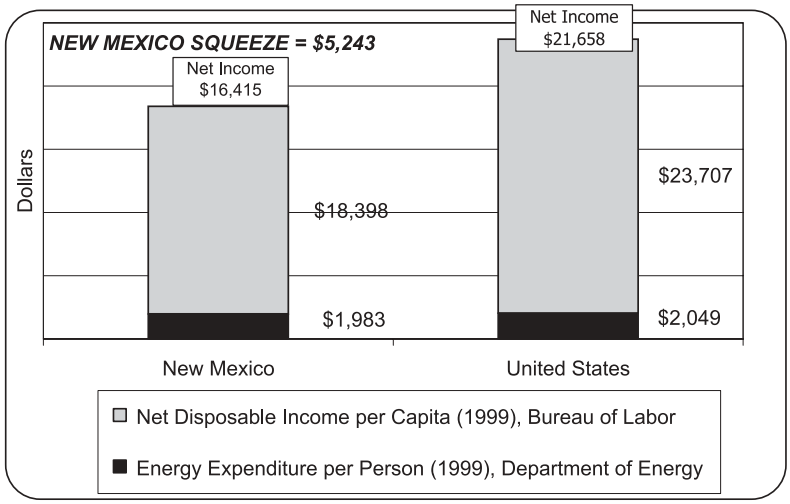
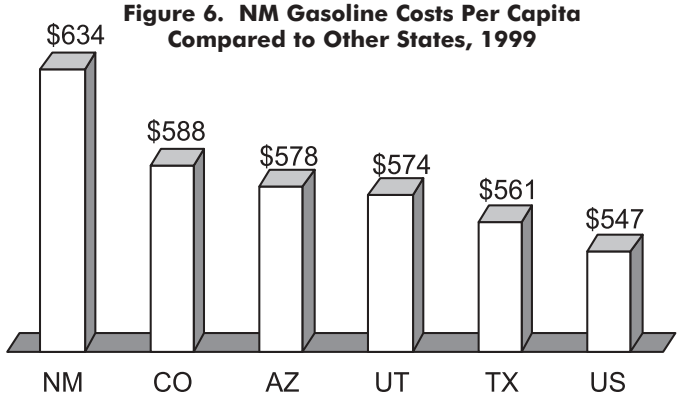


Table 4. NM Rankings in Per Capita Energy Consumption and Expenditures, 1999

Energy Source	New Mexico Ranking*	
	Consumption	Expenditures
Coal	28	22
Natural Gas	29	39
Petroleum	35	35
Electricity	39	37
Total	23	37

* #1 ranking is highest per capita; #50 ranking is lowest.

Figure 6. NM Gasoline Costs Per Capita Compared to Other States, 1999



NEW MEXICO ENERGY CONSUMPTION LANDSCAPE – OPPORTUNITIES TO IMPROVE EFFICIENCY

New Mexicans are squeezed economically by higher-than-average costs per unit of energy and by our lower-than-average disposable income. Annual energy expenditures in the state are $1,983 per capita. Our average net disposable income after energy costs are paid is $18,398 compared to $23,707 nationally – a significant $5,309 less than the national average. The economic squeeze increased significantly from $4,276 in 1997 to $5,243 in 1999. See Figure 5. The residential sector in New Mexico consumes 15% of the total energy in the state compared to 19% for the Nation. Residents of New Mexico are very resource-efficient through use of evaporative cooling for their homes and burning of wood for heating and cooking. We consumed 177,000 cords of wood in our homes in 1995. Very few new houses are built with refrigerated air-conditioning. Cooling with evaporative coolers costs one-third to one-fifth less than cooling with compressor-driven refrigerated air-conditioning. However, there is a significant trend towards refrigerated air-conditioning. New Mexico ranks 23rd in per capita energy consumption and 37th in per capita energy expenditures. See Table 4. A typical New Mexican's gasoline expenditures are also higher than in surrounding states and

Table 5. New Mexico Energy Prices ($/Million BTU) (1999) - Final Cost to Customer

Energy Source	New Mexico	Colorado	Texas	Arizona	Utah	U.S.
Electricity	$19.42	$17.49	$17.85	$21.20	$14.32	$19.37
Cents/kWh*	6.58	5.95	6.04	7.23	4.86	6.66
Gasoline	9.53	9.72	8.88	9.66	10.13	9.31
Natural Gas	3.62	4.26	2.74	5.01	4.04	4.25
Disposable Per Capita Personal Income (1999)	$18,398	$25,485	$23,099	$20,462	$19,247	$23,707

Note: * Average Electricity Revenue Per KWH

Figure 7. Total Energy Expenditures, 1999

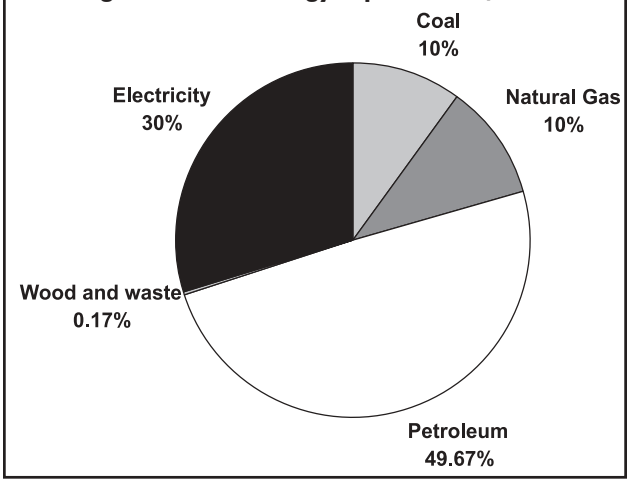
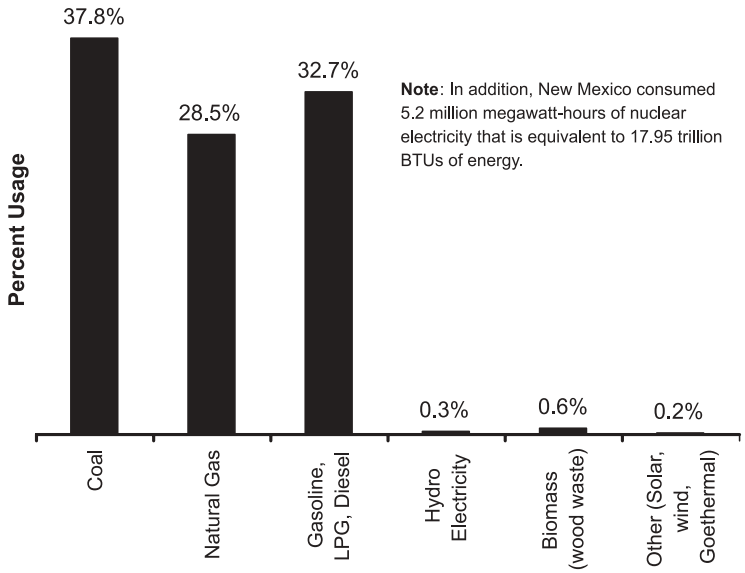


Figure 8. New Mexico Energy Consumption, 1999



Note: In addition, New Mexico consumed 5.2 million megawatt-hours of nuclear electricity that is equivalent to 17.95 trillion BTUs of energy.

Energy Sources Total: 635 Trillion BTUs

DOE/EIA-0214(99), May 2001, Table 203;
NM Public Regulation Commission;
and Public Service Company of NM

nationwide. New Mexicans spent, on average, $634 for gasoline in 1999 compared to $547 nationally. See Figure 6. The unit price paid for electricity in New Mexico is very close to the national average. However, Colorado, Texas and Utah pay significantly lower rates for electricity. Consumers in New Mexico pay more for natural gas than consumers in Texas, but pay less than the remaining surrounding states. See Table 5. The largest payments for energy—over $1.95 billion per year statewide—are for petroleum products such as gasoline, liquefied petroleum (LP) gas, and diesel fuels. Electricity purchased by end users cost New Mexicans over $1.16 billion in 1999. See Figure 7.

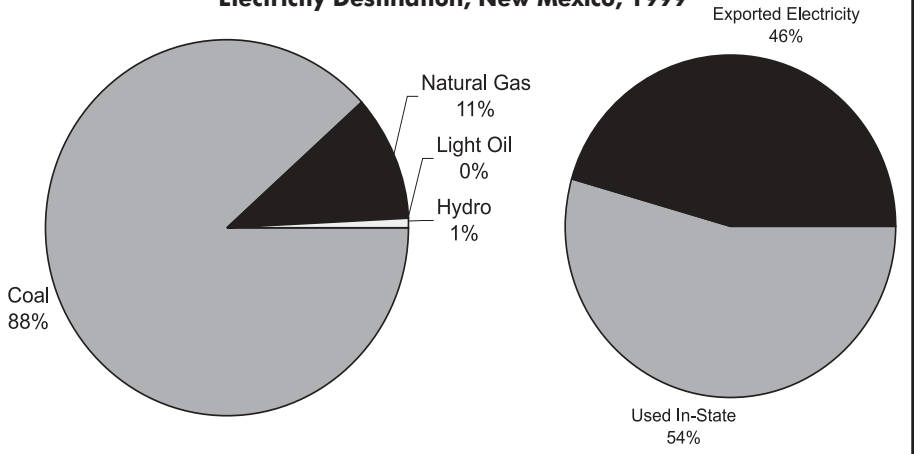
Energy consumption for exported electricity was 19.4% of the total energy consumed by all sectors in the state. See Figure 8 and Table 6. Over 46% of the energy input to electric utilities was exported out of New Mexico. See Figure 9. New Mexico appears to be just as industrialized and commercialized as the Nation from an energy consumption standpoint. In New Mexico, 32% of the energy goes for industry com-

Table 6. New Mexico's 1999 Consumption of Energy Resources in Trillions of BTUs

Energy Source	Amount	Percent %
Coal	298.0	37.8%
Natural Gas	224.7	28.5%
Gasoline,LPG,Diesel	257.4	32.7%
Hydro Electricity	2.5	0.3%
Biomass (wood waste)	4.4	0.6%
Other (Solar, wind, Goethermal)	1.2	0.2%
Total	788.2	
Exported Electricity	-153.1	-19.4%
Net Total (Trillion Btus)	635.1	

Source: DOE's Energy Information Administration

Figure 9. Energy Input to Electric Utilities and Electricity Destination, New Mexico, 1999

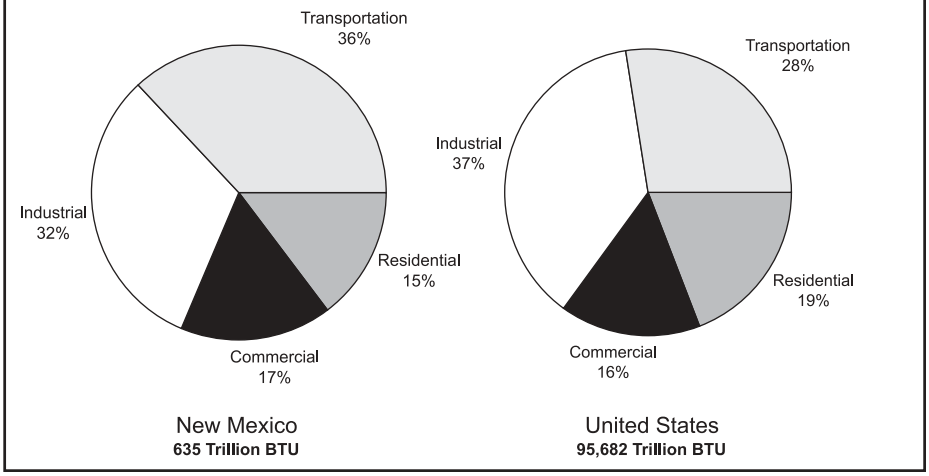


Total Energy Consumption: 335.3 Trillion BTUs

Source: DOE/EIA-0214(99), May 2001, Table 208

pared to the national average of 37%. Commercial energy consumption is slightly higher that the national average. However, a higher proportion of energy (36%) is used in transportation compared to 28% for the nation. On the other hand, New Mexico uses a lower proportion of energy (15%) in the residential sector. See Figure 10.

Figure 10. Energy Consumption by Sector, 1999



RECENT DEVELOPMENTS - ENERGY PRICE AND SUPPLY AWAKENING

Americans consumed almost 20 million barrels of oil per day during 2000, of which almost 60 percent was imported. Almost half of these imports were from member nations of OPEC, the Organization of Petroleum Exporting Countries. Twenty-two percent originated in the Persian Gulf region. In recent years, Mideast crude oil reached $38 per barrel on occasion (excluding the cost of maintaining a military presence to safeguard the resource). These facts speak to our substantial dependence on foreign energy and its seemingly inherent price volatility.

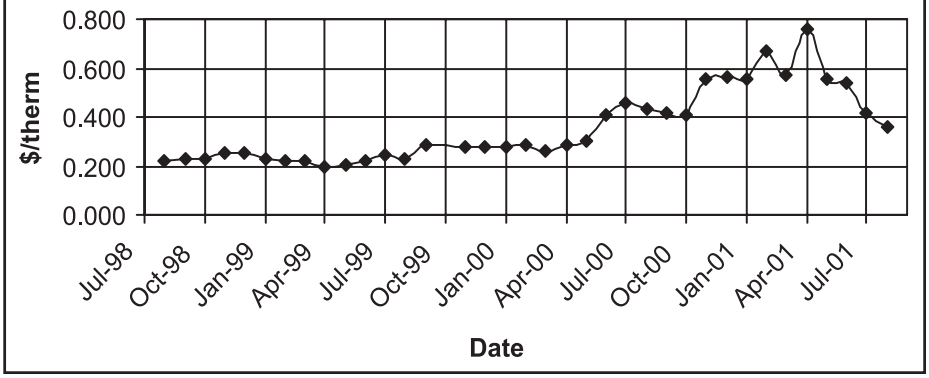
Clearly, energy is an operating cost of our Gross National Product. When that cost increases dramatically, as it did between 1998 and 2000 when the average purchase price of a barrel of crude oil skyrocketed from $8 to more than $30, the results cascade through this Nation's economy. In addition, our reliance on imported oil is a significant contributor to America's chronic balance-of-trade deficit. During 2000, imports of crude oil totaled nearly $90 billion, about 25% of the deficit.

On October 22, 2001, the U.S. Department of Energy's Energy Information Administration (EIA) reported that gasoline, crude oil and natural gas prices had decreased significantly. The average world crude oil price was $19.48 per barrel, down $10.73 from the previous year. WTI crude oil fell to $21.99 per barrel, down $12.32 from the year before. The national average retail regular gasoline price was $l.265 per gallon, down 28.6 cents from the year before. Natural gas prices at the Henry Hub averaged $2.71 per thousand cubic feet (Mcf), a level much lower than the year before. The average spot price for natural gas in the prior year was estimated to have averaged about $4.96 per Mcf. Source: USDOE/EIA

In New Mexico, we saw natural gas, gasoline and other petroleum products fluctuate significantly between calendar year 2000 and 2001. For example, the cost of natural gas for consumers was $0.301 per therm in May 2000. By April 2001, the price had increased to $0.756. Then it dropped to $0.35 per therm in August 2001. [Note: A therm is equivalent to 100,000 Btu.] The information is based on prices shown in the Public Service Company of New Mexico gas billings. See Figure 11.

In New Mexico, public schools, institutions of higher education, and selected state and local governments receive revenues from the sales of oil

Figure 11. Natural Gas Cost Per Therm



and gas. Each $1.00 increase in the price of a barrel of oil brings $4 million more in revenues to the state; and each $0.10 increase in the price per Mcf of natural gas nets the state an extra $12 million. Had prices remained high the full year, the State Treasury may have realized a revenue increase of $297 million for natural gas and $80 million for crude oil, a total of $377 million. In early 2001, oil and natural gas prices were nearly triple that from the year before. However, energy prices declined steadily throughout the year and, as a result, revenues to the State Treasury decreased significantly.

The big question is how the average New Mexico citizen will be impacted. In 1999, New Mexicans paid $2.357 billion for all petroleum and natural gas products based on the latest available data from DOE-EIA. A reduction in price of 20% would increase net disposable income by $471 million. In addition, citizens would save an additional state gross receipts tax of approximately $23.5 million based on a 5% rate.

Renewable Energy Resources

Renewable energy sources, including solar, wind, hydropower, biomass, and geothermal, currently provide less than 1% (or 5.6 trillion BTUs) of New Mexico's energy needs. In fact, the contribution of renewable energy dropped from 6.6 trillion BTUs in 1997. This is contrary to the fact that our renewable energy resource base is very large and diverse. Table 1 provides a breakdown of consumption, by sector, for renewable energy in New Mexico.

Table 1. Renewable Energy Consumption in New Mexico

Sector	Energy Source	Trillion BTUs Consumed
Residential	Geothermal & Solar	0.500
	Wood	3.400
Commercial	Geothermal	0.100
	Wood	0.500
Industrial	Geothermal/Wind/Solar	0.600
	Wood and Waste	0.500
	Total	**5.600**

Source: DOE/EIA State Energy Data Report 1999, printed May 2001.

Table 2. Renewable Energy Production by Resource, 1999

Resource	Billion BTUs Produced	Value ($ Millions)
Fuel Wood	3,500	6.5 (Note 1)
Alcohol Fuels	1,179	23.3 (Note 2)
Hydro Electric	785	15.2 (Note 3)
Geothermal	407	1.4 (Note 4)
Wind	6	0.119 (Note 5)
Total	**5,877**	**46.51**

Notes:
1. DOE/EIA Energy Price and Expenditure Report, 1999.
2. Data from High Plains Ethanol Plant, Portales, NM; 15 million gal/yr @ $1.559 per gallon.
3. Edison Electric Institute, Yearbook 2000; value based on average NM electricity cost of $0.0663/kWh
4. Southwest Technology Development Institute, NMSU; average NM natural gas cost of $3.62/million BTU.
5. Southwest Public Service, Amarillo, TX; Clovis, New Mexico wind turbine, average NM electric price.

Solar

OVERVIEW

The focus on New Mexico as a leader in solar energy has in the past attracted private, state and federal funding, resulting in significant benefits to New Mexico and the Nation. Recently, however, research funding for solar technologies had leveled off or dropped for most entities such as Sandia National Laboratories (SNL). SNL conducts a wide array of solar energy research, development and demonstration (RD&D) projects involving such technologies as parabolic troughs and concentrating collectors. With the event of September 11, 2001, Congress seems intent on restoring to historically high levels funding for most types of domestic energy RD&D, including solar energy, to enhance U.S. energy security.

The solar industry is made of manufacturers, equipment suppliers, greenhouse and glazing suppliers, passive solar builders, installers and service companies that repair systems. Most businesses marketing solar technologies are members of the New Mexico Solar Energy Association (NMSEA) and the New Mexico Solar Energy Industries Association (NMSEIA). In NMSEA's 2001 Directory of Solar

Professionals, 30 architects and designers, 42 builders, 6 education professionals, 4 engineers, 3 financing institutions, 43 solar technology companies, 6 greenhouse designers and builders, and 25 green building product and service companies are listed. NMSEA's resources can be accessed on the WEB at www.nmsea.org or 1-888-886-6765.

In the 1980s there existed both federal and state solar tax credits. During the decade over 40,000 active and passive solar systems were installed in New Mexico. When oil prices fell and the federal tax credit for use of solar was eliminated on December 31, 1985, the impact on the solar energy industry was immediate. At the beginning of 1985, approximately 250 solar businesses were in operation employing about 2,000 people. By the end of 1985 about 80% of these businesses had closed.

The Solar Rights Act of 1978 allows property owners to create solar easements for the purpose of protecting and maintaining proper access to sunlight. It also includes provisions allowing local governments to create their own ordinances or zoning rules pertaining to protection of solar rights. New Mexico was first among the 50 states to enact solar tax incentives and a solar access law.

RESOURCES

Energy from the sun represents a potentially enormous energy source. New Mexico experiences more than 3,200 hours of sunshine per year—substantially more than most other states in the Southwest. New Mexico's solar potential varies from about 6 to 8 kilowatt-hours per square meter per day.

This large resource base means the potential for solar energy in New Mexico is also great. The State's average daily energy consumption is about 904 billion BTUs and is equivalent to the amount of solar energy received on an average day within an 18 square-mile area. The energy is equivalent to 161,425 barrels of crude oil. Table 3 shows the average solar radiation for selected New Mexico communities.

Table 3. Average Solar Radiation in New Mexico

AREA	BTUs/SQUARE FOOT/DAY	
	HORIZONTAL SURFACE	VERTICAL SURFACE
Albuquerque	1,827	1,423
Carlsbad	1,825	1,210
Chama	1,560	1,200
Las Cruces (El Paso)	1,900	1,380
Las Vegas	1,675	1,250
Lordsburg	1,900	1,275
Los Alamos	1,535	1,262
Santa Fe	1,625	1,210
Taos	1,575	1,200
AVERAGE	**1,755**	**1,297**

Source: Los Alamos Scientific Laboratory, USDOE, Passive Solar Design Handbook, Vol. 2, 1980; and NM Climate Manual, Solar and Weather Data, NMERDI-Z2.45, 1985

PRODUCTION

Direct use of the sun's light and thermal energy has long been recognized In New Mexico. Over $4 million worth of energy was supplied by active and passive solar systems in 1990. Although less than five percent of the solar installations in New Mexico generate electricity, these photovoltaic (PV) units include a 47-kilowatt system at the Southwest Regional Experiment Station at New Mexico State University in Las Cruces and about 250 one-kW irrigation units in various areas. Sandia National Laboratories estimated that there were approximately 2,000 PV systems in New Mexico in 1990 and possibly a substantial number more.

RECENT DEVELOPMENTS

Significant activities have been conducted with alternative energy in New Mexico over the past few years. The Energy Conservation and Management Division (ECMD) has implemented major projects that use our extensive solar resource.

ECMD provided funding to the All-Indian Pueblo Council to install an 11 kW solar PV carport at the Indian Pueblo Cultural Center in Albuquerque. The array is now the largest commercial PV array in the state and is expected to produce 25,000 kWh of electricity, save 43 tons of coal, conserve 1 million gallons of water, and reduce carbon dioxide emissions by 27 tons per year. The system will save the Cultural Center over $3,400 per year. The carport will be visible to 400,000 visitors annually. Several large areas in New Mexico, such as

the Pajarito Mesa west of the City of Albuquerque, remain without electricity but could be served with solar PV technologies. Similarly, electricity is not available to 36.8% of households on the Navajo Reservation, 4.7% of the Jicarilla Apache Reservation, 2.7% of Zuni Pueblo, and 1.9% of Acoma Pueblo.

The use of solar energy in our New Mexico State Parks has improved their safety and convenience. ECMD installed 29 solar PV lighting systems at visitor centers, pay stations and other locations in 15 of our State Parks. Also, a solar PV aeration system was installed at the Rio Grande Nature Center to create better conditions for aquatic life.

It should also be noted that older systems installed in the early 1980s have been kept operational. ECMD has made improvements to each 16,000 square foot solar hot water system at the Central and Southern New Mexico Correctional Facilities. The Northern New Mexico Community College also received assistance to make improvements to their solar system.

Wind

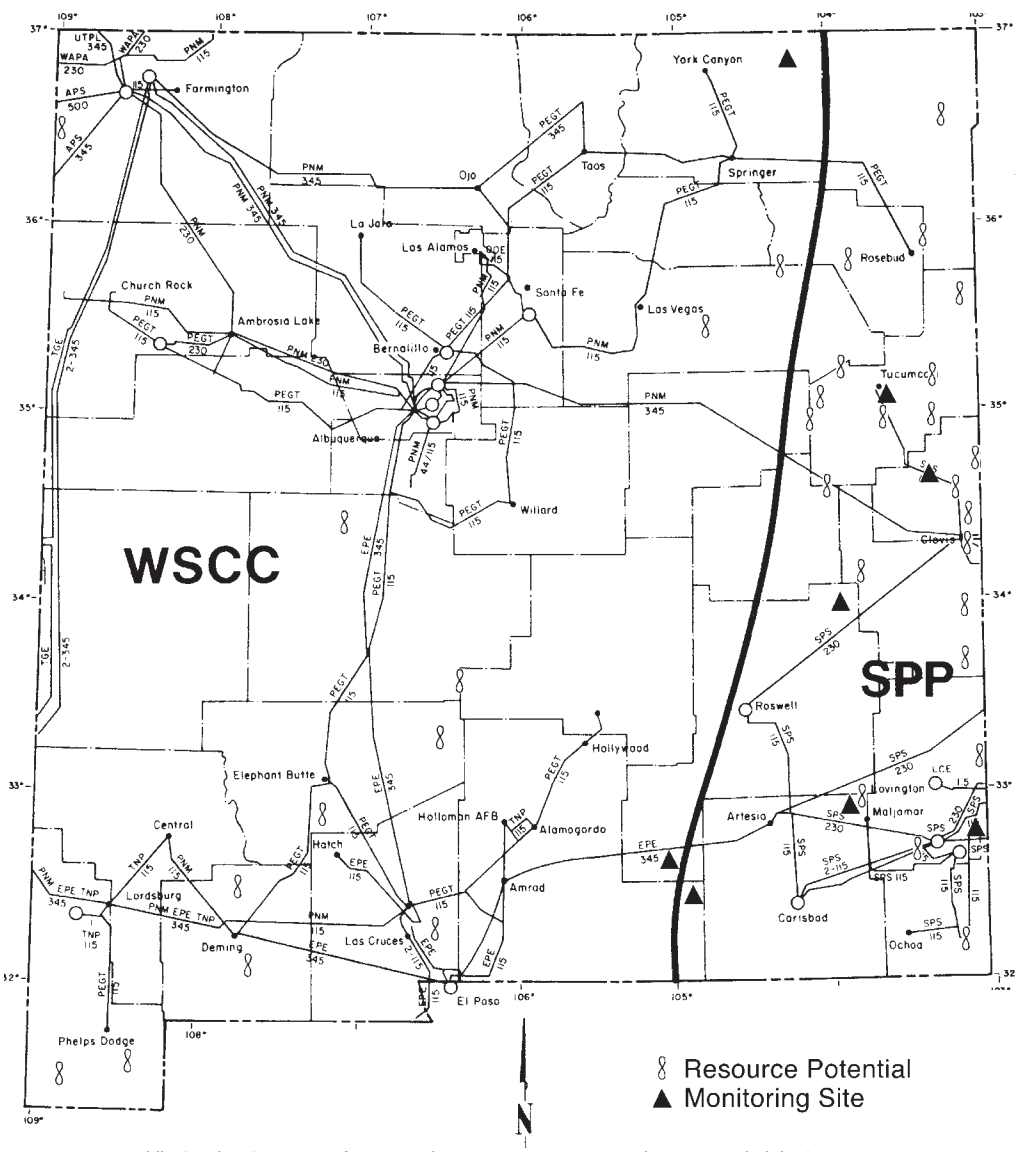
Wind is a proven, cost-effective, and environmentally attractive source of power. Recent technological innovations in wind turbine design have resulted in increased effectiveness and reduced cost. The cost of electricity from wind power plants has dropped to about $0.04 per kilowatt-hour (kWh), very close to the cost of power from fossil-fuel sources. Public utilities across the country and around the world are beginning to include wind in their mix of energy sources. Large wind power plants have recently begun operation in western Texas near the New Mexico border. ECMD assisted Sandia National Laboratory (SNL) and the U.S. Department of Energy (DOE) in their efforts to purchase wind power from Southwestern Public Service Company/Xcel for the Waste Isolation Pilot Plant near Carlsbad.

Although New Mexico has many areas with an abundance of wind energy only one commercial wind turbine has been installed in New Mexico. A 660 kW Vestas wind turbine (see photo) was installed in 1999 near Clovis by The Texas Wind Power Company of Austin,

660 Kilowatt commercial wind turbine near Clovis. Source: ECMD

Texas. A second turbine will soon be installed at the site. Its construction was triggered primarily by SNL's subscription to purchase wind power from Southwestern Public Service's Windsource program. Wind energy activities in New Mexico in recent years have been limited primarily to research. The New Mexico Energy, Minerals and Natural Resources Department (EMNRD) is continuing a detailed wind energy resource assessment of the most promising sites for commercial development. SNL is conducting ongoing research to develop economical wind turbines for power generation.

Figure 1. Potential Wind Power Sites and Existing Transmission Lines



PNM	Public Service Company of New Mexico	UTPL	Utah Power and Light Company
APS	Arizona Public Service Comapny	TGE	Tucson Gas and Electric Company
SPS	Southwestern Public Service Comapny	DOE	U.S. Department of Energy
EPE	El Paso Electric Company	WSCC	Western Systems Coordinating Council
TNP	Texas-New Mexico Power Company	SPP	Southwest Power Pool
LCE	Lea County Electric Cooperative		
WAPA	Western Area Power Administration		

The potential for electricity generation from wind is enormous in some areas of New Mexico, especially on the eastern plains. New Mexico ranks twelfth in wind electric potential and is among twelve states in the midsection of the country that, together, have 90% of the total commercial wind electric potential in the contiguous United States. The annual wind energy potential of New Mexico has been estimated to be 435 billion kWh. New Mexico has the potential to produce many times its own electrical consumption, which puts it in a position to export wind electric power.

EMNRD has initiated a project to perform a detailed wind resource assessment of the state. Phase one of the project, which has been completed, was a partnership with the National Renewable Energy Laboratory. The project was funded by EMNRD, the DOE, and the Public Service Company of New Mexico. These partners recognize that the development of this resource is important to the future economy of the state. Phase one identified sites (see Figure 1) with the highest potential for commercial development taking into consideration all the factors that affect the feasibility of development. Computer analysis and field surveys by an experienced meteorologist were used to obtain useful, accurate results. The project has produced the first detailed wind map of New Mexico. Most of the selected sites with the highest

potential are in the eastern plains because of the good wind resource and availability of power lines for interconnection. The most attractive sites are on mesas and ridges near Tucumcari.

Phase two of the wind resource assessment is actual wind speed monitoring. EMNRD has contracted to have two years of wind speed data collected at six of the most promising sites. Two years of data have now been collected and all of the sites have good wind speed (miles per hour, at 40 meters height): Johnson Mesa (18.1), Frio Draw (16.6), Mesa Redonda (18.6), San Juan Mesa (17.7), Tatum (15.4), Guadalupe Mtns. (16.7).

Such data are vital to commercial development of wind power plants because they allow accurate estimates of power plant production. EMNRD has received requests from, and provided the data to many wind power developers. The six sites selected for monitoring are widely distributed in the eastern part of the state, and include a variety of terrain: plains, mesas, ridges and mountains. The data will be representative of the wind resource at numerous sites with similar terrain. The data may also be used to improve the general accuracy of the State's wind map.

In addition, EMNRD has purchased a smaller, portable monitoring tower that is used to sample wind speed at a height of 10 meters and is easier to move to various locations. The first location selected on Mescalero Ridge in Eddy County proved to be very windy. The instrument will remain for one year.

EMNRD contracted for analysis of the potential economic development benefits of wind power. The work has been completed and reports produced that predict the effects of construction and operation of a 40 MW wind power plant in each of five counties: Eddy, Otero, Quay, Lea, and Colfax. Effects studied include jobs, earnings, sales and revenue.

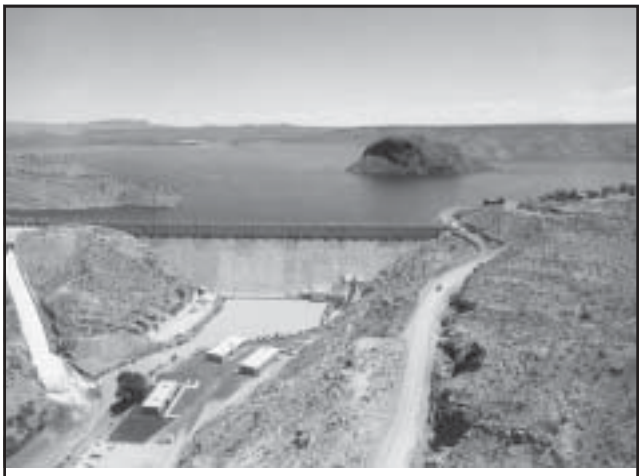
SNL conducts an ongoing wind energy research program that employs a multifaceted approach to the development of economical wind systems for power generation. First, it conducts applied research in aerodynamics, structural dynamics, fatigue, materials, manufacturing, controls, and systems integration to understand unsolved technology problems and to provide better design tools. A major new effort in applied research is the investigation of rare atmospheric events that significantly impact wind turbine long-term structural integrity. Second, SNL applies its analytical and experimental capabilities to solve specific industry technical problems that are impeding the deployment of reliable, cost-effective solutions for domestic and international markets. Finally, advanced manufacturing techniques are being used to reduce cost and increase reliability of wind turbine blades. Follow-on efforts will consider the complete product life cycle, with emphases on fully integrated design, agility, and tools to support a design-for-manufacturing process. In all three approaches, SNL uses formal and informal teaming arrangements to work closely with wind turbine manufacturers, wind farm developers/ operators and other DOE laboratories.

As part of SNL's Blade Manufacturing Improvements project, the firm of TPI Composites produced a prototype blade that incorporates several enhancements to their blade manufacturing process to lower cost and improve quality and reliability. These improvements include the use of the SCRIMP resin infusion technique, the use of reusable silicon bags and heated molds, and the inclusion of an innovative labor-reducing root design. This prototype blade development and the associated improvements in manufacturing led TPI to get back into the blade production business. They recently signed a contract with Mitsubishi to fabricate 110 blades (each 26.5 meters long) for Mitsubishi's 1 MW turbine. These blades will be part of two wind development projects - 14 turbines in Wyoming and 20 turbines in a field near Amarillo, Texas.

A unique measurement campaign being conducted by SNL is the long-term inflow and structural test (LIST) program. The objective of LIST is to obtain long-term (at least one wind season) continuous measurements of the inflow coupled to measurements of the structural response of a wind turbine. Based upon the demonstrated results of the LIST program, SNL is monitoring the performance of one of Enron's 1.5 MW turbines located in the Indian Mesa wind farm near Ft. Stockton, Texas. The wind regime is this area is similar to that encountered in Eastern New Mexico.

Hydropower

New Mexico's hydropower resource base exists in the form of hydroelectric capacity from large dams and reservoirs. The capacity is currently 78.4 megawatts (MW) from 9 plants.



Elephant Butte Dam and Power Plant, Sierra County. Source: U.S. Bureau of Reclamation

PRODUCTION

Hydroelectric plants in New Mexico produce 230 million kilowatt-hours (kWh) per year. See Table 4 for a list of facilities.

Table 4. New Mexico Hydroelectric Production

LOCATION	CAPACITY (megawatts-MW)	ELECTRICITY PRODUCED (million kWh)
Navajo Reservoir – Farmington	30.0	
Elephant Butte – Truth or Consequences	24.3	
Abiquiu	15.0	
El Vado	8.8	
Farmington	0.2	
Alamogordo	0.06	
Raton	0.03	
Cloudcroft	0.015	
Reserve	0.010	
Total	**78.415 MW**	**230 million kWh***

*Year 2000, Edison Electric Institute, Statistical Yearbook.

Biomass

OVERVIEW

Wood burning for heating is perhaps the most traditional use of bioenergy in New Mexico, and this continues to be the largest use. The other common use of bioenergy in New Mexico involves the production of methane from municipal wastewater sludge. This fuel is then burned to heat the digestion process, and in some cases to also generate electricity for operation of the plant.

Bioenergy is produced by combustion of either nonfossil biological feedstock or other products made from such feedstock. The feedstock may be either produced or harvested explicitly for such use, such as grain milo and firewood, or may be a waste stream from agricultural, municipal or industrial sources. Distribution of and access to the resource are critical to the success of bioenergy use. For this reason the creation of bioenergy is often found at the point of availability of a waste stream, with a facility's size determined by that stream. Production of fuel alcohol is covered in another section of this report.

RESOURCES AND PRODUCTION

Annual estimated bioenergy resources are provided in Figure 2. Use of forest products as fuel is perhaps the oldest and most traditional use of bioenergy in New

Mexico. The best available research on New Mexico fuelwood indicates that 197,000 cords (see Figure 3) were harvested in 1986, which is neither a significant drain on the growing stock inventory nor a competitor with the timber products industry. This is equivalent to about 3.6 trillion British Thermal Units (Btu).

Albuquerque and Las Cruces are using the anaerobic digestion of municipal wastewater sludge to generate methane gas. The gas then fuels the production of electricity and heat to power the wastewater facilities. Los Alamos, Roswell and Carlsbad are using the resulting methane to heat the digesting process and/or water. Several sawmills burn waste wood to provide heat for wood drying kilns.

The waste stream bioenergy resource in New Mexico has been studied in detail. The total potential for energy production in this sector is large, at 35 trillion Btu per year, although a large share of this resource is allocated for other uses such as particleboard manufacture. The largest sources in this sector are sawmill/ wood product waste and municipal solid waste.

Figure 2. NM Annual Estimated Potential and Actual Bioenergy Resource

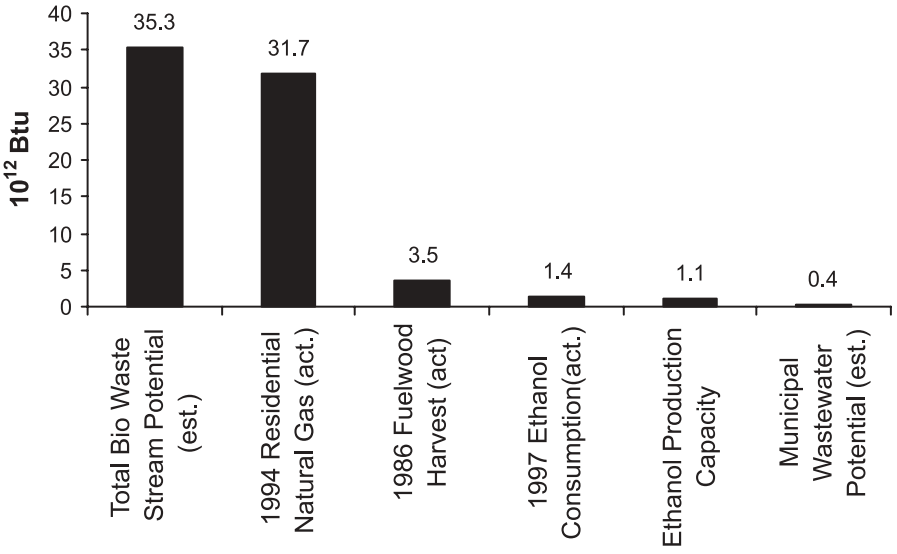


Figure 3. New Mexico's 1986 Fuelwood Harvest

Species	Harvest cords	Proxy Species	Wet kBtu/cord	Dry kBtu/cord	Dry Energy million Btu
True Fir	3,763	White Fir	12,149	14,212	53,480
Alligator Juniper	24,984	Alligator Juniper	14,868	17,288	431,923
Other Juniper	48,883	Utah Juniper	17,433	20,149	984,944
Spruce	6,188	Engelman Spruce	9,126	10,880	67,325
Pinion	33,041	Pinyon Pine	16,045	18,737	619,089
Ponderosa Pine	24,152	Ponderosa Pine	14,152	16,173	390,610
Douglas Fir	9,407	Douglas Fir	13,044	15,330	144,209
Cottonwood	9,901	Aspen	10,715	12,576	124,515
Aspen	3,733	Aspen	10,715	12,576	46,946
Mesquite	1,238	Mesquite heartwood	20,411	24,029	29,748
Oak	6,538	Gambel Oak	17,792	21,163	138,364
Other Hardwoods	25,370	Gambel Oak	17,792	21,163	536,905
Totals	197,198				3,568,059

Harvest data does not include wood from waste stream of other industries.
Energy indicated is potential, or as if burned at 100% combustion efficiency.
Harvest data from New Mexico's 1986 Fuelwood Harvest, US Dept of Agriculture, Forest Service
Energy content data from Arizona Forestry Notes #19, School of Forestry,
Northern Arizona University, Glenn Voorhies author, July 1983.

RECENT DEVELOPMENTS

Several new bioenergy projects are underway in New Mexico. The City of Albuquerque and New Mexico State University are carrying a long-term study of a municipal solid waste bioreactor design into the field-scale construction phase. The cities of Las Cruces and Ojinaga Mexico are jointly studying a process for growing fuelwood with wastewater sludge.

The U.S. Forest Service is working with the State Forestry Division on two wood chip fueled power systems at Jemez Mountain schools and the Glorieta Conference Center. Groups in Silver City and Angel Fire are studying use of lumber mill residues and forest thinnings for fueling a bioenergy project. New Mexico State University's demonstration of a tumbleweed harvester could help make this high-energy material a practical energy source.

Rapid growth of the New Mexico dairy industry has greatly increased the production of manure in New Mexico. The State of New Mexico is working with the U.S. Department of Energy to develop a project involving the use of a bioreactor to produce methane from this waste. Dona Ana County pecan growers are exploring the feasibility of using pecan grove waste to fuel generation of electricity.

Geothermal

OVERVIEW

New Mexico has significant low-temperature (<194 degrees Fahrenheit) geothermal resources along its western border and in close proximity to the Rio Grande from north to south. Our state is also blessed with considerable moderate- to high-temperature resources, including those in the Rincon area of Dona Ana County, near Cotton City in Hidalgo County, and the Valles Caldera area in the Jemez Mountains (Sandoval County). See Table 5.

PRODUCTION AND USE

Geothermal resources in New Mexico have been used directly in a significant manner for over 20 years. In the 1980s, a large district heating system was installed at New Mexico State University (NMSU) in Las Cruces; and the largest geothermal greenhouses in the nation were constructed. A key factor responsible for encouraging the development and use of geothermal energy at that time was a $600,000 appropriation from the New Mexico State Legislature for geothermal research, development and demonstration (RD&D) projects. EMNRD-ECMD, with substantial technical assistance from the Southwest Technology Development Institute (STDI) at NMSU, established and implemented the geothermal RD&D projects. Subsequently, STDI constructed a geothermal greenhouse research and business incubator facility in Las Cruces, as well as a geothermal aquaculture facility co-located on site. As a direct result of these efforts, four commercial greenhouses totaling over 30 acres have been established in southern New Mexico. STDI estimates that these four geothermally heated greenhouses represent a capital investment of more than $10 million, generating at least $14 million in annual sales and about 270 jobs. One of the largest geothermal aquaculture facilities in the Nation is also located in New Mexico, in the Animas Valley south of Lordsburg. This facility is owned and operated by Americulture, Inc. Table 6 provides information on the various direct-use geothermal applications in New Mexico. To date, however, the state has not witnessed construction of any commercial-scale geothermal electric generation plants.

Table 5. New Mexico Geothermal Resources

SITE	TEMPERATURE (° F)	FLOW (GPM)	#WELLS	DEPTH (FT)
Dona Ana County:				
Las Cruces	156.9	3	9	2572
Radium Springs	170.1	Na	8	121
Grant County:				
Faywood	127.4	3	1	Na
Hurley	144	Na	1	521.7
San Juan/ Sherman	138.2	3	8	Na
Hidalgo County: Cotton City	225	200	13	439
McKinley County: Ft. Wingate	131	23	1	1942
Rio Arriba County: Ojo Caliente/Gallegos	132.1	Na	2	88
San Miguel County: Las Vegas	131.3	Na	2	Na
Sandoval County:				
Jemez/San Ysidro	136	150	1	239
Jemez Springs	163.9	52	6	Na
Valencia County: Valencia	176	na	1	721

Source: Witcher, J.C., 1995b. A Geothermal Resource Database, New Mexico; Southwest Technology Development Institute, New Mexico State University, Technical Report to Oregon Institute of Technology, Geo-Heat Center, 32 p.

Table 6. New Mexico Geothermal Applications

Sources: Geothermal Energy Association geo@geo-energy.org

SITE	T (°F)	FLOW (GPM)	ENERGY 10^9 BTUs/YR	APPLICATION
Catron County	NA	NA	NA	Resort & Spas—Bubbles Hot Springs
Dona Ana County:	142	417	45.9	District Heating (NMSU)
Las Cruces area	148	50	1.8	Greenhouse—STDI (NMSU)
	148	700	27.6	Greenhouse—J & K Growers
Radium Springs	160	2600	119	Greenhouse—2nd largest nationally Masson Farm
Hidalgo County: Cotton City	245	2000	209	Greenhouse—Largest nationally Burgett Floral
	185	NA	0.7	Greenhouses— Beall &McCants
Rio Arriba County	115	60	2.0	Resorts & Spas— Ojo Caliente
Sandoval County	NA	NA	NA	Resorts & Spas— McCauley Hot Springs, Jemez Springs Bathhouse
	165	40	1.3	Space Heating— Jemez Springs Fire Department
Sierra County	113	NA	NA	Resorts & Spas— Truth or Consequences
	Total		**407.3**	