ENERGY EFFICIENCY, CONSERVATION AND RENEWABLE ENERGY RESOURCES

The Energy Conservation and Management Division (ECMD) was created by statute as an organizational unit of the New Mexico Energy, Minerals and Natural Resources Department. [Section 9-5A-4 NMSA 1978]. We plan and administer "clean energy" programs, including renewable energy, energy efficiency and conservation, and alternative transportation/ fuels. Anticipated benefits resulting from ECMD's programs are a reduction in energy consumption and expenditures; generation of new jobs and revenues; environmental protection and improvement (*e.g.*, reducing emissions of air pollutants and greenhouse gases); enhancement of public health; decreased consumptive water use for power generation; lessened dependence on foreign oil; and greater energy security and independence. Programs include:

Renewable Energy. Solar, wind, geothermal, biomass, and hydrogen technology applications in all sectors; distributed energy technologies such as fuel cells and district heating systems; co-generation (combined heat and power).

Energy Efficiency and Conservation. Technology applications such as energy control systems and efficient lighting, motors and appliances, as well as behavioral practices, that reduce energy use and costs in buildings and the transportation sector; residential/ commercial building energy codes and standards.

Alternative Transportation/Fuels. Ridesharing/carpooling; park-and-ride programs; vehicles and infrastructure for use of clean-burning fuels such as compressed natural gas (CNG), propane, ethanol (E-10, E-85), electricity, and bio-diesel.

These ECMD programs are accomplished through policy research and planning; state and federal legislative activities; data collection and analyses; public education and outreach; technical assistance; administration of federal grants for technology deployment and demonstrations; project development, implementation and evaluation with public- and private-sector partners; intradepartmental/interagency cooperation and coordination.

For the tenure of the Administration of Governor Bill Richardson, ECMD has adopted the following Mission Statement: *Develop and implement effective clean energy programs—renewable energy, energy efficiency and conservation, alternative transportation/fuels—to promote environmental and economic sustainability for New Mexico and its citizens.*

A number of programmatic objectives have been established by ECMD to help accomplish its mission. These include:

RENEWABLE ENERGY OBJECTIVES:

- ten percent (10%) of New Mexico's electricity needs met with renewable energy by 2010; and
- position New Mexico among the top three states in wind energy production by 2007.

ENERGY EFFICIENCY OBJECTIVES:

- reduce energy consumption in all sectors of the New Mexico economy, including residential, commercial, industrial, institutional (government/schools), and transportation;
- promote and facilitate sustainable, energy-efficient ("green") building construction practices throughout New Mexico.

ALTERNATIVE TRANSPORTATION/ FUELS OBJECTIVES:

- facilitate compliance with state and federal mandates for acquisition of alternative fuel vehicles; and
- assist and encourage the increased use of alternative fuels.

ENERGY EMERGENCY RESPONSE OBJECTIVE

- make necessary preparations to help ensure the provision of adequate assistance to New Mexico citizens and businesses in the event of an energy emergency.

The ensuing sections of this report discuss ECMD programs and activities aimed at achieving the preceding objectives.

ENERGY EFFICIENCY AND CONSERVATION

OVERVIEW

Energy efficiency and conservation are resources that can lower consumer energy bills and increase the disposable income of New Mexicans. They offer many low-cost options that can be implemented by

Insulation and radiant heating, Highway Department Maintenance Building.

all economic sectors in New Mexico. Energy efficiency and conservation technologies are cost-effective, commercially available, quickly implemented and are an important part of the solutions to our energy needs. Significantly, energy efficiency and conservation technologies generate savings from the date of installation through the useful life of the product.

Sound energy policy recognizes that energy efficiency and conservation are energy resources readily available to virtually every consumer. In many cases energy efficiency and conservation resources save more energy than is measured by a building's utility meters in that there are no transportation/transmission or conversion losses.

There is a difference between energy efficiency and energy conservation. For example, replacing an old inefficient furnace with a new, more efficient furnace is considered an efficiency measure. Similarly, installation of additional insulation in an old home improves the building shell efficiency of a house. Installing a time-clock thermostat is, however, considered an energy conservation measure. With a time-clock thermostat, the temperature can be reduced with no one noticing, while the occupants are away or sleeping, and less energy is consumed. Less energy service was provided by the furnace but it went unnoticed by the occupants. Conservation measures can have no up-front costs if the occupants make a conscious effort (behavioral change) in resetting the existing thermostat when they leave their homes or go to sleep.

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 (ESCOs) have implemented well over $25 million in 36 energy efficiency projects - primarily in public schools and universities, saving over $3.9 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.

In summary:

- Energy efficiency and conservation increases disposable income.
- Energy efficiency and conservation empower users to control energy costs.
- The least expensive energy is that which is not consumed.
- Energy efficiency is the cheapest energy that money can buy.
- Energy conservation can be free with a little human creativity.
- Higher energy consumption creates opportunities for efficiency.
- Businesses that implement efficiency have a competitive edge.

EFFICIENCY PROGRAMS AND ACCOMPLISHMENTS FOR 2003

Energy Conservation and Management Division (ECMD) administers and manages a number of energy efficiency programs in partnership with various private- and public-sector entities. Included are the following:

State Government Energy Management Program

Beginning in 1992 with Executive Order 92-20 and continuing through Executive Orders 96-30 and 99-40, state agencies have been directed to reduce energy consumption and costs in state buildings. To accomplish this directive, the ECMD serves as lead agency and assists state agencies by providing annual ECMD grants for energy efficiency improvements and technical assistance. Result from the last Executive Order showed a 17.5% reduction in energy consumption and approximately $1.2 million in cost savings. ECMD has maintained a utility bill database that is the sole centralized repository for energy expenditures. The database currently contains nearly 1,700 accounts from 30 utilities. Current state utility expenditures total $13.6 million per year, including electricity, natural gas, LP gas, water, sewer and garbage disposal.

Table 1. Public School Construction Plans Reviewed

	FY 00-01	FY 01-02	FY 02-03
Additions (sq. ft.)	850,293	1,362,304	1,391,734
Renovations	1,113,117	2,084,133	1,533,533
Students Served	53,176	62,254	73,293
Total Construction Cost	$138,477,818	$206,750,412	$231,843,373
# of Plans Reviewed	94	103	122

Retrofit projects funded under this program:

- Central NM Correctional Facility: Energy-efficient lighting, $30,482; completed 6/30/03.
- Farm and Ranch Museum: Efficient museum lighting, $3,176; completed 6/30/03.
- Office of Cultural Affairs: Efficient lighting, energy controls, insulation, $45,698; completed 6/30/03.
- Department of Transportation: Insulation and natural gas radiant heating in 5 shops, $31,915; completed 6/30/03.
- Forestry Division (Tree House) Improvements: Insulation, insulated garage door, $10,000; completed 9/30/03.
- Southern NM Correctional Facility: Repair solar field controls and install new Direct Digital Controls system, $13,592; completed 9/30/03.
- Las Vegas Medical Center: Energy-efficient lighting, sensor-operated water faucets and lavatories, $33,000; completed 9/30/03.
- Department of Public Safety: Lighting efficiency improvements, $9,489; completed 6/30/03.
- Ft. Bayard Medical Center: Boiler efficiency improvements, $20,000; completed 12/31/03.

Public School Energy Efficiency

ECMD works with school districts throughout New Mexico in an effort to improve their facilities' energy efficiency, thereby lowering energy costs while making the classroom environment more comfortable and thus conducive to learning. Under an agreement with the State Department of Education, ECMD reviews all school construction plans to ensure compliance with applicable building energy codes and standards. An average of over 100 projects totaling more than $200 million have been reviewed in recent years.

Energy Smart Schools

ECMD is partnering with the Albuquerque Public School (APS) District to initiate an "Energy $mart Schools" project. This project will be a model of high-energy efficiency. The intent is to save energy and money, while also functioning as an on-site educational laboratory for the study of energy efficiency and management. The APS E-school is expected to use 41% less energy by using daylighting instead of electric lights, advanced controls, better insulating windows, efficient mechanized equipment and systems. The federal DOE funded $60,000 of the Energy $mart School Project, with APS providing matching funds of $50,000.

Energy Performance Contract (EPC) Review

ECMD provides review and approval of state/local governments' performance contracts under the Public Facility Energy Efficiency and Water Conservation Act [Sections 6-23-1 to -10, NMSA 1978] to certify that projected savings are reasonable and accurately estimated. ECMD currently has 36 energy performance projects with an estimated annual cost savings of $3.9 million. This year a proposal from City of Albuquerque Housing Services was approved. The project will save $1.4 million in energy and water costs per year in 28 public housing units. In addition, a project for the College of Santa Fe was approved. The project will cost $769,261 and will save $108,879 and enough power for 366 homes. In addition, ECMD continues to work with past EPC participants to resolve problems that may surface in contracts that are still active.

Rebuild America/ Rebuild New Mexico

ECMD continued to provide for operation of the Rebuild America/ Rebuild New Mexico program, a public-private partnership to promote energy efficiency in buildings. Program energy audits have identified potential savings of more than $1,000,000 per year for Rebuild partners. The program offers walk-through audits, energy information and workshops, third-party review of energy proposals and other technical assistance. Such assistance was also provided to 22 tribes and pueblos in New Mexico, with 100,000 square feet of public buildings audited.

One of the biggest success stories involves Rebuild's work with Albuquerque Public Schools (APS). This initiative involves a focus on behavioral energy efficiency procedures at 28 APS schools. Under the program, over $292,000 in energy costs and 3.5 million kilowatt-hours per year have been

Table 2. Energy Efficiency Retrofits: Estimated Fiscal Impact (Dollars In Thousands)						
Fiscal Year	General Fund Cost	General Fund Savings	Other Funds Cost	Other Funds Savings	Net Cost/Gain To General Fund	Change In FTE
2004		0	4,000		0	
2005		1,600	4,000		1600	
2006		3,200	4,000		3200	
2007		4,800	4,000		4800	
2008		6,400	4,000		6400	
Total		16,000	20,000		16,000	

saved. In addition, an "Energy Patrol" education-action program was developed, impacting over 600 students, teachers and members of the public. As a result, the National Energy Foundation selected APS' Cleveland Middle School as "School of the Year" in New Mexico.

Building Energy Codes and Standards

ECMD has been working for several years to encourage the Construction Industries Commission (CIC) to upgrade New Mexico's residential and commercial building energy codes. We have secured a sizable ($150,000) federal grant to assist in providing technical analyses and training of builders, contractors and other construction personnel. In addition, ECMD staff provides technical assistance to over 100 builders each year to ensure compliance with energy code requirements. The Energy Policy Act of 1992 (EPACT) [Public Law 102-486] requires states to update building energy codes by July 2004.

PROPOSED EFFICIENCY INITIATIVES

In 2003, ECMD proposed as part of Governor Bill Richardson's *Performance Review—Moving New Mexico Forward* a number of new efficiency initiatives. These initiatives are intended to save taxpayer dollars while enhancing the delivery of constituent services.

Energy Efficiency Retrofit Projects.

Significant energy and cost savings can be achieved through energy efficiency retrofits in buildings. In particular, the opportunities in New Mexico state government are enormous. For example, public schools, universities and Cabinet-level state agencies spent over $75.3 million on utilities in FY 2002, including $51.3 million for electricity, $17.3 million for natural gas, and $2.4 million for liquefied petroleum gas. Similarly, in the year ending June 30, 2003, public schools added over 1.3 million square feet of new space and renovated approximately 1.5 million square feet of existing schools; the value of this construction amounted to $231 million covering 122 projects that year.

Facility managers in all sectors - commercial, industrial and institutional - can initiate pursuit of their most promising opportunities by identifying buildings that have not yet been targeted for energy efficiency practices and technological retrofits. The installation of energy efficient lighting in buildings can reduce lighting energy consumption by as much as 50 percent. Also, installation of appropriate building controls can reduce heating energy consumption by 10% or more by reducing electrical and natural gas consumption during unoccupied periods. Cooling cost savings can also be realized.

To date, much attention has been focused on utilizing New Mexico's Public Facility Energy Efficiency and Water Conservation Act to effect state building energy efficiency retrofits through what is known as "energy performance contracting." This is where an energy efficiency contractor is compensated utilizing the savings in utility costs that the government entity realizes through efficiency projects. Depending on the circumstances, this can be an effective approach—particularly if an agency does not have the up-front capital for a desired project. With energy performance contracting, however, the "net gain" of utility cost savings is not realized until after the contractor has been fully compensated; this can sometimes take 5-10 years.

Given these considerations, ECMD proposed an initiative to enhance the efficiency of state buildings and schools through lighting retrofits and the installation of energy control systems. Under this proposal, state funds would be allocated upfront for the retrofits and in-house labor would be utilized to the maximum extent practicable. As a result, contractor and financing costs are minimized while allowing utility cost savings to accrue to the state general fund from day one of project implementation.

ECMD has proposed that four million square feet of state buildings be retrofitted each year from FYO4 (2003-04) through FYO9 (2008-09) at a total cost of $20 million. While actual savings will begin to accrue immediately in FYO4, no FY04 savings have been included in the table due to the time required to effect the retrofits in the first year. The first full year of system-wide savings (20 million square feet) will occur in FY09 and will generate $8 million per year in savings thereafter. Based on retrofit experience and research, $400,000 per year in utility savings will be realized for every 1 million square feet of space retrofitted at a cost of $1,000,000 (a 2.5-year "pay back" period). The savings are cumulative (*i.e.* retrofit projects

Table 3. Natural Gas Direct Purchases - Estimated Fiscal Impact (Dollars in Thousands)

Fiscal Year	General Fund Cost	General Fund Savings	Other Funds Cost	Other Funds Savings	Net Cost/Gain To General Fund	Change in FTE
2004	0	$1,210	NA	NA	$1,210	None
2005	0	$1,210			$1,210	
2006	0	$1,210			$1,210	
2007	0	$1,210			$1,210	
2008	0	$1,210			$1,210	
Total	0	$6,050			$6,050	

accomplished in earlier years continue to provide savings in subsequent years).

Natural Gas Purchase Options

Significant savings on natural gas purchases can be realized if all state agencies utilize natural gas marketing price agreements. The Building Services Division (BSD) of the NM General Services Department (GSD) has a natural gas marketing price agreement in place that is working well. After deregulation of the natural gas utility industry, it became possible for consumers to purchase natural gas directly from producers for a substantial cost savings. Savings to state agencies have been proven for utilization of natural gas marketing price agreements. The current state contract allows for three pricing options: 1) Purchase with a guaranteed 7% savings over the tariff price. This option requires a one-year commitment. 2) Purchase natural gas using index pricing at the beginning of each month from the San Juan Basin. Savings vary from month to month. 3) Purchase natural gas using the gas futures market, in packages of three or four months. Purchases are made months in advance. This method offers the greatest potential savings and the greatest potential risk.

Currently, BSD is using a combination of index pricing and negotiated price purchasing to achieve a minimum of 12% savings over PNM pricing. Since the first agreement was put in place in 2001, Cabinet - level state agencies, the City of Albuquerque, and the City of Farmington have saved $142,450 compared to PNM prices. Besides BSD and the cities above, other state entities taking advantage of the price agreement include the Corrections Department, Office of Military Affairs, and the Public Employees Retirement Association. Much larger potential savings are possible if all agencies were directed to use the existing agreement. It should be noted that GSD is not authorized to purchase natural gas for other state agencies.

While there is the potential for greater savings in the latter two options, the guaranteed 7% savings option is risk-free. With NM public schools, institutions of higher education and Cabinet-level state agencies spending over $17 million annually for natural gas, the potential combined savings for all three entities would be at least $1.2 million per year.

Higher Energy Standards for New Buildings

Significant energy cost savings in the construction and future operation of new state facilities can be achieved by requiring that all new state buildings meet or exceed the 90.1-1999 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standard or latest version. Federal law (Energy Policy Act of 1992) requires states to update their commercial energy code to the most recently approved U.S. Department of Energy (DOE) code. ASHRAE Standard 90.1-1999 fulfills this mandate. To comply with the mandate, states are required to upgrade their existing commercial building codes by July 15, 2004. Many states have adopted this basic energy standard for all their state building construction. However, New Mexico remains with the 1986 Model Energy Code that is over 17 years old for commercial buildings and is woefully inadequate with respect to energy efficiency.

While it is recognized that energy-efficient retrofits reduce operating costs, many are under the impression that it is more costly to construct an energy efficient (*i.e.*, ASHRAE compliant) building. This is not necessarily the case depending on a variety of factors. Some energy efficiency construction elements increase the cost of construction while others decrease the cost.

Table 4. Higher Energy (ASHRAE) Standards - Estimated Fiscal Impact (Dollars in Thousands)

Fiscal Year	General Fund Cost	General Fund Savings	Other Funds Cost	Other Funds Savings	Net Cost/Gain To General Fund	Change in FTE
2004		$ 189.80		$ 2,001.00	$ 189.80	None
2005		$ 379.20		$ 2,001.00	$ 379.20	
2006		$ 568.80		$ 2,001.00	$ 568.80	
2007		$ 758.40		$ 2,001.00	$ 758.40	
2008		$ 948.00		$ 2,001.00	$ 948.00	
Total		$ 2,844.00		$ 10,005.00	$ 2,844.00	

Natural gas bus and alternative Transportation — City of Santa Fe.

A DOE study conducted specifically for ECMD concluded that for every one million square feet of public schools constructed to meet the ASHRAE standard, $1.37 million in construction costs are saved. This is because certain energy efficiency measures (passive lighting, reducing the "heat load" of the building) result in lower costs for lighting and heating, ventilation, and air conditioning (HVAC) systems (*e.g.*, fewer light fixtures, fewer chillers for cooling, etc.). Construction costs for higher education facilities are slightly higher with ASHRAE compliance: ~$393,000 per one million square feet. This is because those higher education facilities, unlike public schools construction, are not currently required to incorporate certain energy efficiency measures that increase construction costs. This construction cost increase is comparatively small given that construction costs can average $100 million per million square feet and also recognizing the impressive annual reductions to energy-related operating costs savings ($244,000/year – roughly a 1.5 year "pay back" period).

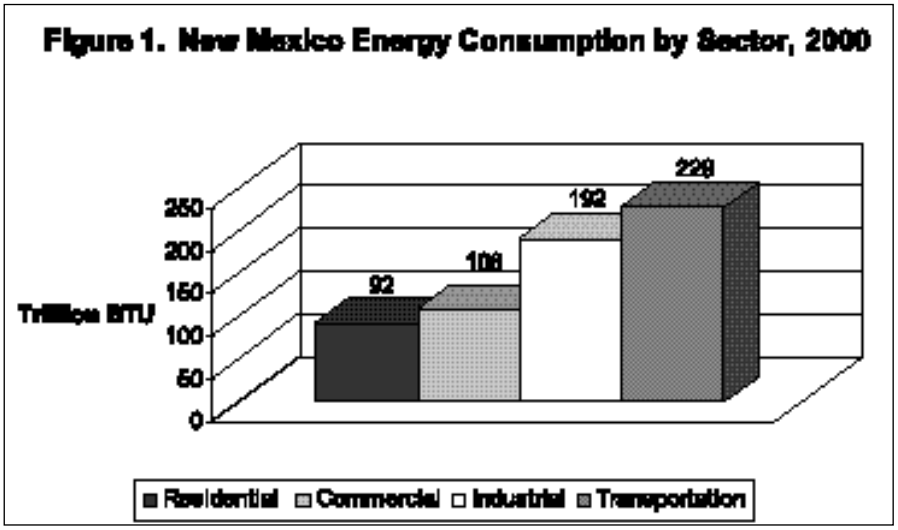
Operating (utility) cost savings for ASHRAE-compliant buildings (versus existing construction standards) are estimated at $103,000/million ft^2/year for public school buildings. For this estimate, 1,500,000 square feet/year of new and renovated construction are assumed. On average, public schools have added 1.0 million square feet over the last 6 years; and, they have renovated an average of 1.2 million square feet per year over the same period. It is estimated that nearly half of the renovated space could benefit from a new energy code. Higher education facilities can realize savings of $244,000/million ft^2/year by incorporating ASHRAE measures into construction. Higher education adds about 150,000 square feet of space per year.

The following table shows the combined fiscal impact for public schools and institutions of higher education.

TRANSPORATION EFFICIENCY AND ALTERNATIVE FUELS

The Energy, Minerals and Natural Resources Department through ECMD promotes the use of alternative fuels and energy efficiency in New Mexico's transportation sector. ECMD manages the Alternative Transportation Program and has established goals to reduce and displace conventional petroleum-based fuel consumption.

Transportation strategies and federal regulations have guided efforts to increase the use of alternative fuels and the use of more efficient, less polluting vehicles. The Clean Air Act of 1970 (amended in 1977 and again in 1990) began the effort to clean up



air pollution; subsequently, the Federal Energy Policy Act of 1992 (EPACT) mandated the accelerated acquisition of alternative fuel vehicles. In 1992, New Mexico enacted legislation now known as the Alternative Fuel Vehicle Acquisition Act [Sections 13-1B-1 to –7, NMSA 1978] and developed an energy policy goal to meet EPACT and State requirements, and to increase use of New Mexico's own abundant energy resources.

Transportation is the largest energy-use sector and a major source of air pollution in New Mexico. While the transportation sector accounts for 28% of the energy consumed in the United States, New Mexico's energy consumption comes in at 36% of the total energy used. The U.S. Department of Energy's Energy Information Administration (EIA) reports that in 2000, New Mexico's energy consumption exceeded 621 trillion BTUs and the transportation sector accounted for 229 trillion of the total. Petroleum fuel is the major fuel source for New Mexico's transportation sector, accounting for 80% of the energy used.

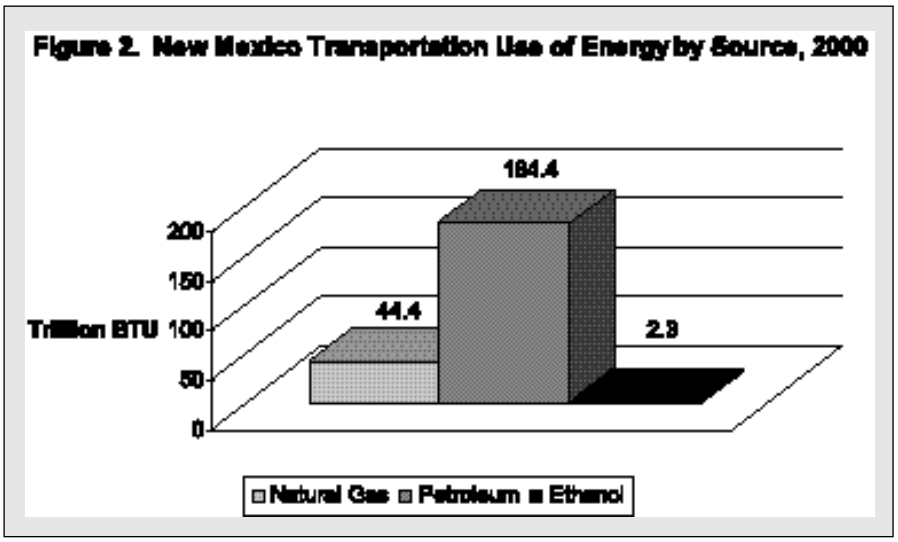
The use of petroleum products in the national transportation sector alone exceeds total domestic oil production by 2 million barrels per day and is projected to triple by the year 2010. Fossil fuel use in transportation is a focal point of both environmental and energy concerns. Using petroleum for transportation has implications for our health, environment and energy security. Transportation influences the lives of all citizens as it affects national security, quality of the environment, links to other people and places, economic well-being, safety, and access to educational and social activities. Safe and efficient transportation supports the freedom, opportunity and air quality that all citizens value.

There are options to reducing our reliance on foreign sources of petroleum. One option is to use alternative fuels; another is to use fuels more efficiently by purchasing fuel-efficient vehicles and ridesharing. There are a variety of fuels that fall under the alternative fuel definition, including natural gas (both compressed and liquefied), liquefied petroleum gas (propane), ethanol (E85), electricity, hydrogen and biodiesel. New Mexico currently ranks second in natural gas production and third in reserves in the continental United States, and is home to an ethanol production plant, and has great potential to promote the use of other alternative fuels including biodiesel and hydrogen.

Hydrogen is currently identified as an alternative fuel under the New Mexico Alternative Fuel Vehicle Acquisition Act and as a renewable energy if derived from non-fossil fuels under the Renewable Energy Portfolio Standard [Section 17.9.573 New Mexico Administrative Code; www.nmcpr.state.nm.us/nmac/] and the Renewable Energy Production Tax Credit [Section 7-2A-19, NMSA 1978].

In an effort to establish New Mexico as the first hydrogen economy in the nation, an alliance known as the Hydrogen Technology Partnership (HyTeP) was formed consisting of representatives from industry, business, research laboratories, academia and government to work together to enhance economic development in New Mexico through a cooperative focus on hydrogen and fuel cell research, development, demonstration and commercialization. The state is building upon some 25 years of research both at Los Alamos National Laboratory and the NASA Johnson Space Center-White Sands Test Facility. In addition to hydrogen and fuel cell research, the state of New Mexico has an abundance of both renewable and non-renewable resources from which to produce hydrogen. The state ranks 2nd in production and 3rd in known reserves of natural gas, 2nd in solar energy resources, 12th in wind potential, and a yet-to-be-determined amount of biomass resources derived from agricultural, forest, and non-hazardous municipal solid waste streams.

Hydrogen is viewed by many as a clean fuel or clean energy carrier because it does not produce harmful CO_2 emissions when burned and its only byproducts are heat and pure water. Although the most abundant element in the universe,



hydrogen rarely occurs as a free-standing element in nature, but rather must be extracted from water or hydrocarbons. The most common and cost-effective means of generating hydrogen today is through steam reforming of natural gas. However, the long-term goal is to produce hydrogen from renewable sources such as biomass or the electrolysis of water using solar and wind. By combining hydrogen with fuel cells, one may generate, store and achieve a high level of efficiency while using clean energy.

There are several applications for hydrogen and hydrogen fuel cells. The three primary applications are: portable, stationary and automotive. The state of New Mexico is currently evaluating the potential for each of these application areas. Several demonstration projects are currently under development to test and evaluate these technology applications. One such project proposes to build upon current compressed natural gas refueling infrastructure to provide hydrogen refueling for demonstration vehicles while supporting the alternative fuel initiatives currently underway in the state. Excess hydrogen would be used within a stationary fuel cell to provide back-up power or onsite electrical generation and storage. Other planned projects would utilize the state's existing wind energy facilities to demonstrate the production of hydrogen using renewables.

Table 5. Acquisition of State Alternative Fuel Vehicles (AFVs)

Model Year Reported	Number of AFVs
2003	365
2002	145
2001	280
2000	111

ECMD's strategy to assist and encourage the use of alternative fuels and to facilitate compliance with state and federal mandates is being accomplished through securing federal U.S. Department of Energy Special Project funding and through the State Energy Transportation Program. The outcomes of the federally funded projects are to:

•Develop an Ethanol (E-85) and Biodiesel (B-20) fueling station infrastructure in New Mexico to serve existing federal and state E-85 fleets and to provide biodiesel to diesel vehicle fleets;

•Develop publicly accessible compressed natural gas (CNG) fueling stations in New Mexico including Las Cruces, Las Vegas, Socorro, Santa Fe and Albuquerque;

•Purchase and retrofit compressed natural gas (CNG) school buses for New Mexico schools;

•Create a support system for alternative fuel use through an established alternative fuel and pollution training curriculum within the Santa Fe Community College;

•Facilitate compliance with federal and state mandates requiring purchase of alternative fuel vehicles for State fleets.

Efforts to increase public and government agency awareness of alternative fuels have included an annual Alternative Fuels Day at the New Mexico State Fair (Expo New Mexico), attendance at environmental, transportation and other related workshops and conferences, and on-site visits with government fleet operators. ECMD was recently awarded grants by the U.S. Department of Energy to support the ongoing work of the Land of Enchantment Clean Cities Coalition and to provide universal card readers at E-85 stations as well as a series of videos, public service announcements and print media regarding the availability and benefits of using E-85.

The key to alternative fuel infrastructure development is fleet growth and fuel usage. New Mexico school districts and transit agencies that use compressed natural gas to fuel fleet vehicles assist in the effort to build New Mexico's alternative fuel infrastructure.

New Mexico's acquisition of alternative fuel vehicles is facilitated by the increased availability of alternative fuel vehicles from automobile manufacturers; many new models are being introduced into the vehicle market including ethanol flex-fuel vehicles, and gas-electric hybrid vehicles.

To reduce petroleum fuel consumption and traffic congestion, and to help improve air quality, ECMD provides support and funding to develop rideshare programs that encourage commuters to use carpools, vanpools, public transportation, and park-and-ride systems to get to their destinations. The ridesharing and park-and-ride activities have shown significant fuel cost savings, reduced vehicle-miles traveled and displaced 3.5 million gallons of gasoline in a one-year period (FY2003), as indicated in Table 6.

Table 6. Fuel Savings

Agency	Reduced vehicle-miles traveled	Number of gallons of fuel displaced	Estimated fuel cost savings
Las Cruces Rideshare	41,463,800 miles	3,488,150	$5,404,274
ABQ Balloon Fiesta	960,239 miles	13,727	$20,590

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 annual energy needs. The contribution of renewable energy has dropped from 6.6 trillion BTUs reported in 1997. This is contrary to the fact that our renewable energy resource base is very large and diverse. Table 7 provides a breakdown of consumption, by sector, for renewable energy in New Mexico.

Table 8 shows the most currently available data on production from renewable energy sources in New Mexico. The estimated value of this production is $46.5 million. The data shown does not include production from wind power development completed in 2003.

A significant amount of renewable energy research, development and demonstration (RD&D) activity in New Mexico occurs through federal government programs at Sandia National Laboratories (SNL). At the time this was written, federal government funds were not yet appropriated, but SNL funding for solar thermal systems and buildings in FY 2003 is estimated to be $3-4 million and the photovoltaics program is expected to receive $5 million. In other renewable energy RD&D areas, the previous FY 2002 appropriations were: energy storage at $6.5 million; geothermal drilling technology at $6.4 million; wind at $3.9 million; and biopower electricity at $1.1 million.

Table 7. Renewable Energy Consumption In New Mexico, 1999

Sector	Energy Source	Trillion BTUs Consumed
Residential	Solar	0.5
	Wood	3.4
Commercial	Geothermal	0.1
	Wood	0.5
Industrial	Geothermal, Wind, and Solar	0.6
	Wood and Waste	0.5
Total		5.6

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

Table 8. 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)
Hydroelectric	786	16.2 (Note 3)
Geothermal	407	1.4 (Note 4)
Wind	6	0.119 (Note 5)
Total	5,877	48.51

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. Southwestern Public Service, Amarillo, TX; Clovis, New Mexico wind turbine, average NM electric price.

SOLAR

Overview

The position of New Mexico as a leader in solar energy in the 1970s and 1980s attracted private, state, and federal funding, resulting in significant benefits to New Mexico and the nation. Funding has fluctuated since that time. Many solar pioneers of the private sector have survived, evolved, and continued forward to provide innovative products and services to the state and the world. ECMD has been involved in most state-funded solar programs and continues, along with the NMSU Southwest Technology Development Institute, to be a primary contact where the state is involved.

At federal laboratories in New Mexico, research funding for solar technologies was dropped at Los Alamos National Laboratory and has decreased at SNL. SNL conducts a wide range of solar energy research, development, and demonstration (RD&D) projects involving technologies such as solar thermal concentrating collectors, photovoltaic (PV) system components, solar buildings, and manufacturing. The new mission of enhanced U.S. energy security, or "energy surety," appears to have led to increased emphasis at federal laboratories for most types of domestic energy RD&D, including solar energy. Energy surety includes design of "microgrids" for essential facilities. Solar energy could be utilized to provide a portion of the secure energy needed after a disaster disables conventional delivery infrastructure.

The solar industry is composed of manufacturers, equipment suppliers, greenhouse and glazing suppliers, passive solar builders, installers, and service companies. Most

businesses marketing solar technologies are members of the New Mexico Solar Energy Association (NMSEA) and/or the New Mexico Solar Energy Industriy Association (NMSEIA). In NMSEA's *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 at www.nmsea.org or 1-888-886-6765.

Table 9. Average Solar Radiation In New Mexico

AREA	BTUs/SQUARE FOOT/DAY HORIZONTAL SURFACE	BTUs/SQUARE FOOT/DAY 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	1,536	1,262
Santa Fe	1,825	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 *New Mexico Climate Manual, Solar and Weather Data*, New Mexico Energy Research and Development Institute 2-72-4523, 1985.

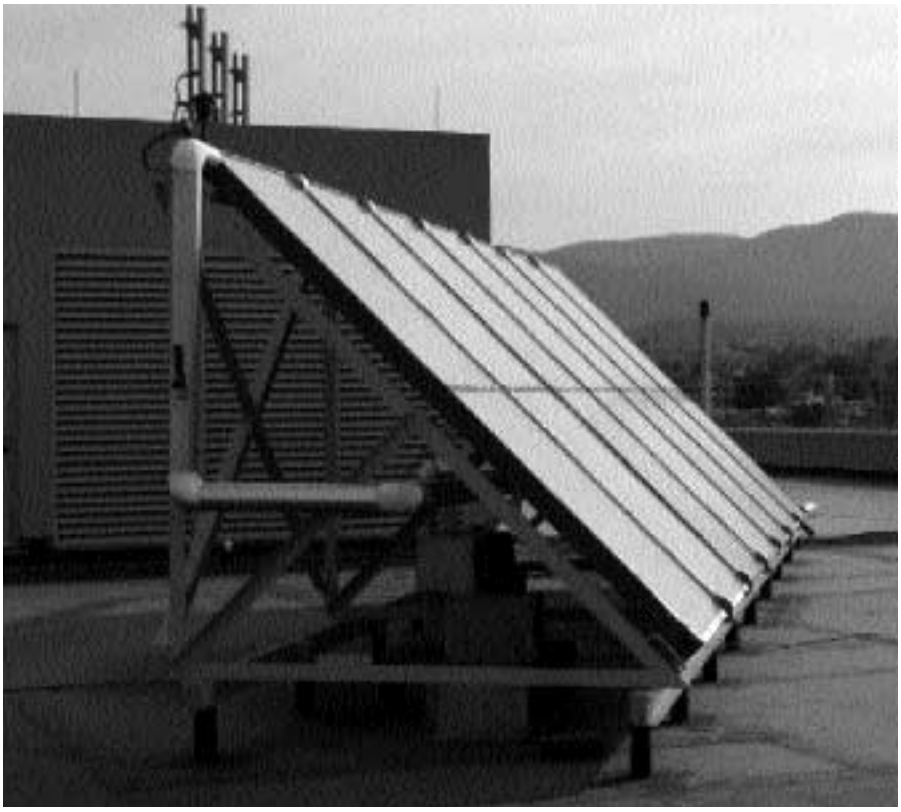
In the 1980s there existed both federal and state solar tax credits. During that decade over 40,000 active and passive solar systems were installed in New Mexico. When oil prices fell and the federal tax credit for use of solar was eliminated in December 1985, the impact on the solar energy industry 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. However, in recent years there appears to be increased activity for solar businesses in New Mexico, due to increased interest in PV systems. A solar and wind tax credit bill (S.B. 348) was proposed in the 2003 Regular Session of the New Mexico State Legislature, but did not pass.

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 a solar access law and also implement tax incentives for solar systems.

Resources

Energy from the sun is an enormous, albeit intermittent, energy source. Solar energy resources are available at high levels uniformly throughout New Mexico and sunshine is experienced more than 3,200 hours per year. This results in a range of solar energy on a horizontal surface—depending on location and season — of about 900 to 2600 BTUs per square foot per day (3 to 8 kilowatt-hours (kWh) per square meter per day).

The potential for converting solar energy to electricity and heat in New Mexico with existing and emerging technologies is also great. The state's average daily energy consumption is about 904 billion BTUs (265 million kWh) or 161,425 barrels of crude oil, which could also be collected as solar energy within an 18 square-mile area.



Solar domestic hot water system at Montoya Building, South Capital Complex in Santa Fe, with 290-square-foot collector array.

Table 9 presents the average solar radiation for selected New Mexico communities.

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, by system types such as solar water heating, solar thermal space heating, and PV. As an example, a PV collector array the size of a football field would directly produce 1.2 million kilowatt-hours of electricity per year, or the electricity needed to power about 122 homes. Assuming a conservative retail electricity cost of five cents per kilowatt-hour, this PV system could offset $500 per year in utility costs for each home.

Although less than five percent of the solar installations in New Mexico generate electricity, PV systems include a 47-kilowatt array at the Southwest Regional Experiment Station at New Mexico State University in Las Cruces, operated by Southwest Technology Development Institute (SWTDI); and upwards of 250 one-kW irrigation units in various areas. SNL estimated that there were approximately 2,000 PV systems in New Mexico in 1990.

Electric utilities in the state are required to provide information on alternative energy systems to remote customers with less than a 25-kW load who request line extensions. This requirement applies when the cost of the requested line extension is greater than 15 times the estimated annual revenue from the line extension. In such cases, utilities must provide customers with information on suppliers of alternative energy systems.

Grid-interconnected photovoltaic system at Rio Grande High School, Albuquerque, with 1-kW DC power input array; Contractor is Sacred Power.

Another type of solar energy production is commonly provided in New Mexico through innovative architecture in buildings: passive solar design. Following design guidelines published by the National Renewable Energy Laboratory (NREL), it is possible for strategic placement of windows, sunspaces, thermal storage walls, and mass (e.g., concrete, brick, adobe), as well as appropriate orientation and insulation, to enable the sun to provide up to 80% of a home's annual space heating needs in New Mexico. This can be achieved without compromising cooling needs. The sun can also be utilized to integrate daylighting, thereby offsetting electricity costs associated with lighting. Passive solar design is also applied to commercial buildings and schools in New Mexico.

By integrating passive solar design, solar water heating, and PV in residential home design it is conceivable to greatly reduce or eliminate the need for conventional electricity, heating, and cooling energy sources. Many success stories exist in New Mexico of living "off-grid." As noted above, solar professionals resident in New Mexico are available for design assistance.

Recent Developments

Significant activities have been conducted with solar energy in New Mexico over the past few years. ECMD has implemented major projects that use our extensive solar resource. ECMD each year provides public information and educational activities on solar energy at various conferences, workshops, and other venues, including the *Taos Solar*

Festival, New Mexico State Fair, and the New Mexico Solar Energy Association's *Solar Fiesta*.

ECMD is refocusing its solar program to feature demonstrations of solar water heating and PV systems. Demonstrations of solar water heating and PV systems will be sited at public school facilities in several New Mexico climate zones. In 2003 ECMD launched the *Schools with Sol* Solar Demonstration Program and selected the following school districts as participants: Albuquerque, Truth or Consequences, Roy, Questa, Jal, Reserve, Santa Fe, Grady, and Alamogordo. ECMD has allocated $100,000 in 2003 for this program. To date, the program has assisted in the installation of a 2.6-kW PV system at Sandia Mountain Natural History Center and a 1-kW PV system at Rio Grande High School (Albuquerque). Both of these systems are interconnected with the utility grid operated by Public Service Company of New Mexico (PNM). The demonstrations are intended to educate and involve students, faculty, staff, and communities at public schools; collect system performance data in different New Mexico climate zones; evaluate incentives for solar technology applications; and address related issues such as state agency administration of residential tax credits, system certification, and system monitoring. ECMD is collaborating with schools, utilities, other state agencies, solar contractors, manufacturers, DOE, SNL, and NREL to make this program work.

ECMD is also collaborating with NMSEA, Southwest Research and Information Center, and other organizations to finance and install PV systems for low-income communities without electricity service. Several large areas in New Mexico, such as the Pajarito Mesa west of the City of Albuquerque, remain without utility-provided electricity, but could be served with PV technologies. Similarly, electricity service is not available to 37% of households on the Navajo Reservation, 5% of the Jicarilla Apache Reservation, 3% of Zuni Pueblo, and 2% of Acoma Pueblo. The majority of households in unincorporated Colonias communities along the border with Mexico are also without electricity service. These communities often resort to expensive means of producing their own electricity, using power sources such as diesel generators and car batteries. PV systems could be a cleaner and possibly less expensive alternative for the critical needs of lighting and operating simple appliances.

ECMD provided funding to the All-Indian Pueblo Council to install an 11-kW PV carport at the Indian Pueblo Cultural Center in Albuquerque. This 1999 installation is the largest commercial PV array in the state and the largest PV system on Indian lands. It 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 in electricity costs. The carport also provides shade for 11 parking spaces and will be visible to 400,000 visitors annually. In 2003 the installation was removed temporarily for another IPCC construction project, but will be relocated at the site in 2004.

In September 1999, the New Mexico Public Regulation Commission (PRC) issued a rule requiring all utilities regulated by the PRC to offer net metering for cogeneration facilities and small power producers with systems of 10 kW or less. [Section 17.10.571, New Mexico Administrative Code; www.nmcpr.state.nm.us/nmac/] Municipal utilities are exempt because they are not regulated by the PRC. There is no statewide cap on the number of systems eligible for net metering.

The use of solar energy in our New Mexico State Parks has improved their safety and convenience. ECMD installed 29 PV lighting systems at visitor centers, pay stations, and other locations in 15 State Parks. Also, a PV aeration system was installed in a pond 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 at state facilities have been kept operational. ECMD made improvements in the 1990s to both 16,000-square-foot solar water heating systems at the Central and Southern New Mexico Correctional Facilities. ECMD is currently assisting these facilities with further improvements. The Northern New Mexico Community College also received ECMD assistance to reactivate solar air heating systems on two major campus buildings. In the 1990s, the General Services Department reactivated a 290-square-foot solar water heating system at the Montoya Building in Santa Fe, which provides most of the domestic hot water needs in that building.

ECMD, SWTDI, and PNM are collaborating on a study of "islanding" on the utility grid. This is a condition where the utility grid experiences reverse transmission flow due to independent power production by a customer, which is associated closely with PV systems interconnected with the utility grid. The database produced will greatly assist utility engineers and PV system designers to better understand these conditions. In 2003 DOE awarded ECMD $223,000 for this project through a competitive process.

WIND

Overview

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 3 cents 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.

Wind Power Plant in New Mexico

In July 2003 the first commercial-size wind power plant in New Mexico commenced operation. Known as the New Mexico Wind Energy Center, it is 204 megawatts in capacity, the third largest wind power plant in the world. It is located in eastern New Mexico, about 20 miles northeast of Fort Sumner, in Quay and De Baca counties. The wind power plant is owned and operated by FPL Energy and all the electricity is purchased by PNM.

PNM has instituted a "green tariff" program that allows interested customers to buy wind-generated electricity for a small monthly premium. Any power from the facility not directed toward the residential and business customer subscription program would be sold on the wholesale market, either within New Mexico or outside the state.

PNM sees the power produced by this facility as a way to recognize and respond to interest within New Mexico in renewable energy and to strengthen the company's wholesale generation portfolio for years to come. When PNM plans a new facility or commits to buying power from a new facility, it looks not just at current economic conditions but also at conditions that may exist several years down the road.

Energy produced at the New Mexico Wind Energy Center will likely replace an equivalent amount of power coming from facilities powered by fossil fuels, since the majority of power on the grid does come from fossil-fuel sources. The addition of energy from the New Mexico Wind Energy Center changes PNM's generation portfolio. Wind now comprises 8 percent of PNM's overall generation capacity, which is the portfolio's peak potential output. However, because of the intermittent nature of wind, the facility's output is expected to comprise about 4 percent of the energy actually produced by or for PNM over the course of a given year.

The energy center will bring more than $40 million into rural De Baca and Quay counties over 25 years. This includes $450,000 per year in payments in lieu of taxes to be made to the county governments and school districts; about $550,000 per year in lease payments to landowners; and an estimated $500,000 in salaries for the permanent jobs to be created.

Resource Assessment

The Energy Conservation and Management Division, through its Wind Power Program, has performed a critical role in the development of wind power in the state. In particular, the data ECMD provided to FPL Energy and PNM was very valuable to the development of the recently announced 204 megawatt project described above. ECMD continued data collection at Frio Draw for a third year upon request to assist FPL Energy in their evaluation of potential sites.

ECMD's Wind Power Program is continuing detailed wind energy resource assessment in order to promote further commercial development. In partnership with the National Renewable Energy Laboratory, ECMD contracted to have TrueWind Solutions, LLC produce a high resolution (200 meters) wind map of the state

New Mexico Wind Energy Center near Fort Sumner: 137 turbines, 320 feet high, 204 megawatts. Photo by: Michael McDiarmid

using the latest techniques. The map was completed and delivered in June 2003. The high resolution allows assessment of wind over detailed terrain features. Maps of wind speed are available at heights of 30, 50, 70 and 100 meters. A wind power map is available at 50 meters. The map is interactive with many GIS layers.

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.

ECMD's Wind Power Program has provided detailed wind resource assessments of the state and high quality wind data to 33 wind power developers, PNM, land owners and others. ECMD has provided two years of wind speed data collected at six promising sites. Three years of data have been provided at two of the those sites. Monitoring of an additional seventh site on Argonne Mesa, southwest of Santa Rosa, was commenced in August, 2002. Such data are vital to commercial development of wind power plants because they allow accurate estimates of power plant production. Several developers are actively working to develop projects in New Mexico. In August 2003 Excel Energy and Cielo Wind Power announced plans to develop an 80 MW wind power plant in New Mexico on the Caprock south of Tucumcari. The plans depend upon renewal of the Federal wind energy production tax credit.

ECMD'S Wind Power Program has provided studies of the potential economic benefits of wind power to five counties: Eddy, Otero, Quay, Lea, and Colfax. Reports have been presented to these counties. In 2002 the program has completed development the following products:

- New Mexico Wind Power Plant Site Screening Model
- Guidelines for Developers and Investors Interested in Wind Power in New Mexico
- New Mexico Wind Development Handbook
- Mesa Redonda Case Study Report. This study includes: environmental, archeological, cost estimating, transmission, permitting, geotechnical, micro siting, production, and visual.

Policy

In the 2002 legislative session, legislation was passed to provide incentives for renewable energy production. The Renewable Energy Production Tax Credit provides for a credit of one cent per kwh for eligible power plants with capacity of at least 10 MW. The legislation directs EMNRD to administer the provisions and certify eligible power plants. ECMD staff has developed the necessary rules to administer the tax credit and has processed two applications for the credit. Legislation was also passed to allow power plants to utilize industrial revenues bonds and to exempt certain wind power plant equipment from gross receipts tax.

In 2002 the New Mexico Public Regulation Commission (PRC) continued hearings and workshops on their proposed rulemaking to require electricity providers to include renewable energy as a resource. The Commission issued a final rule that requires 10% renewable energy by the year 2011 with intermediate requirements. The PRC rule also requires utilities to offer an optional green power tariff so that those customers willing to pay more for renewable power will be able to purchase larger amounts of renewable power.

Research

Sandia National Laboratories 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, Sandia 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 emphasis on fully integrated design, agility, and tools to support a design-for-manufacturing process. In all three approaches, Sandia uses formal and informal teaming arrangements to work closely with wind turbine manufacturers, wind farm developers/operators and other DOE laboratories.

BIOENERGY

Introduction

Bioenergy is produced from biomass, which is defined as organic matter including but not limited to agriculture or animal waste, small diameter timber, salt cedar and other phreatophyte or woody vegetation removed from river basins or watersheds, landfill gas and anaerobically digested waste biomass. Biomass feedstock may be either produced or harvested explicitly for such use as grain milo and firewood, or may be a waste stream from agricultural, municipal or industrial sources. Access to and transportation of biomass resources are critical to the economical use of bioenergy. 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.

Wood burning for heating is perhaps the most traditional use of bioenergy in New Mexico and continues to be the largest use. Another less 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. Production of fuel alcohol is covered in another section of this report.

Resources and Production

New Mexico possesses an abundance of biomass resources that may be used in the production of energy and other high value products and fuels. Resources include forest thinnings from federal, state and private lands, agricultural crops, animal manure, and non-hazardous municipal solid waste.

Use of forest products as fuel is probably the most common use of bioenergy in New Mexico. The best available research on New Mexico fuel wood indicates that 197,000 cords 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 3.6×10^{12} British Thermal Units (Btu).

An assessment of forest material was conducted under a grant from the U.S. Forest Service utilizing data from 1994-1998 of timber supply on state and private land within 14 counties in New Mexico (divided between two regions). Assuming that small diameter, cull wood and whole trees (bark and needles) could be utilized in bioenergy plants, it was determined that Region 1 could sustain approximately 2,679 oven-dry tons of small-diameter material annually, and Region 2 could sustain approximately 32,184 oven-dry tons annually.

In addition, New Mexico ranks first in the nation in average dairy herd size, with 170 dairies throughout the state. There are approximately 300,000 cows at the dairies which produce approximately 2.6 million dry tons of manure per year.

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 and Carlsbad are using the resulting methane to heat the digesting process and/or water. Historically, sawmills have burned 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 can be diverted to other uses such as particleboard manufacture. The largest sources in this sector are sawmill/ wood product waste and municipal solid waste.

Recent Developments

Recognizing the growing interest in biomass in the state, EMNRD convened the Biomass Industry Development Working Group, which brought together private industry, federal, state, and local government, tribal, national laboratories and academia to develop a coordination process to encourage and assist in the development of a viable biomass industry in New Mexico, resulting in improved forest health and increased use of domestic biomass resources to stimulate economic development. This process will include assessing opportunities, current projects, end products (biofuels, biopower and bioproducts), supply, technologies, incentives, barriers, funding and economics. As a result of the Working Group, a website has been established to provide access to biomass resource assessments and key contacts from around the state. In addition, the group has formed three subgroups to work on feedstock assessments, legislative/regulatory issues and market development.

In addition, the EMNRD was awarded a two-year grant by the Department of Energy, Office of Industrial Technologies to implement the Industries of the Future Program in New Mexico. One of the two focus industries selected was the forest products industry. The goal of the program is to identify and implement energy efficiency and pollution prevention

solutions in collaboration with the industrial sector. The Industries of the Future Program is working closely with existing forest product businesses (sawmills, furniture manufacturers, construction material manufacturers, etc.) to consider the use of bioenergy within their operations thereby achieving energy efficiency and reducing their overall waste stream.

There are currently two bioenergy projects in New Mexico that use forest thinnings. One of the projects is located in Glencoe, New Mexico and the other at Zuni Pueblo. Both projects are using wood chips in small-scale bio-power units to produce heat and power. Both projects are in the demonstration phase and will assist in fast-tracking the technology to commercialization.

Rapid growth of the New Mexico dairy industry has created a large manure resource in New Mexico. The State of New Mexico and New Mexico State University are working with the U.S. Department of Energy and the Dairy Producers of New Mexico on a research feasibility project to create electricity and heat from this resource.

Biomass is recognized in both the Renewable Energy Portfolio Standard Rule and the New Mexico Renewable Energy Production Tax Credit as a source of renewable energy.

GEOTHERMAL

Overview

New Mexico has significant low-temperature geothermal resources—less than 90 degrees Celsius (C) or 194 degrees Fahrenheit (F)—along its western border and in close proximity to the Rio Grande from north to south. Common low-temperature applications are space heating and water heating. Our state is also blessed with considerable moderate-temperature resources—90 to 180 degrees C (194 to 356 degrees F)—including those in the Rincon area of Dona Ana County and near Cotton City in Hidalgo County. The table below provides a summary of geothermal applications in New Mexico.

In FY 2000-01, DOE directly funded a number of private-sector resource assessment and demonstration projects in southern New Mexico, which are now getting underway.

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 in Dona Ana and Hidalgo counties. 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. ECMD, with substantial technical assistance from the Southwest Technology Development Institute (SWTDI) at NMSU, established and implemented the geothermal RD&D projects. Subsequently, SWTDI 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. SWTDI

Table 10. New Mexico Geothermal Applications

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

SITE	T (°F)	FLOW (GPM)	ENERGY 109 BTUs/YR	APPLICATION
Catron County	NA	NA	NA	Resort & Spas—Bubbles Hot Springs
Dona Ana County: Las Cruces area	142	417	45.9	District Heating (NMSU)
	148	50	1.8	Greenhouse—SWTDI (NMSU)
	148	700	27.6	Greenhouse—J & K Growers
Radium Springs	160	2600	119	Greenhouse—2nd largest nationally Musson Farm
Hidalgo County: Cotton City	245	2000	209	Greenhouse—Largest nationally Burgett Floral
	165	NA	0.7	Greenhouses/Aquaculture—McCants/AmeriCulture
Rio Arriba County	115	60	2	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	

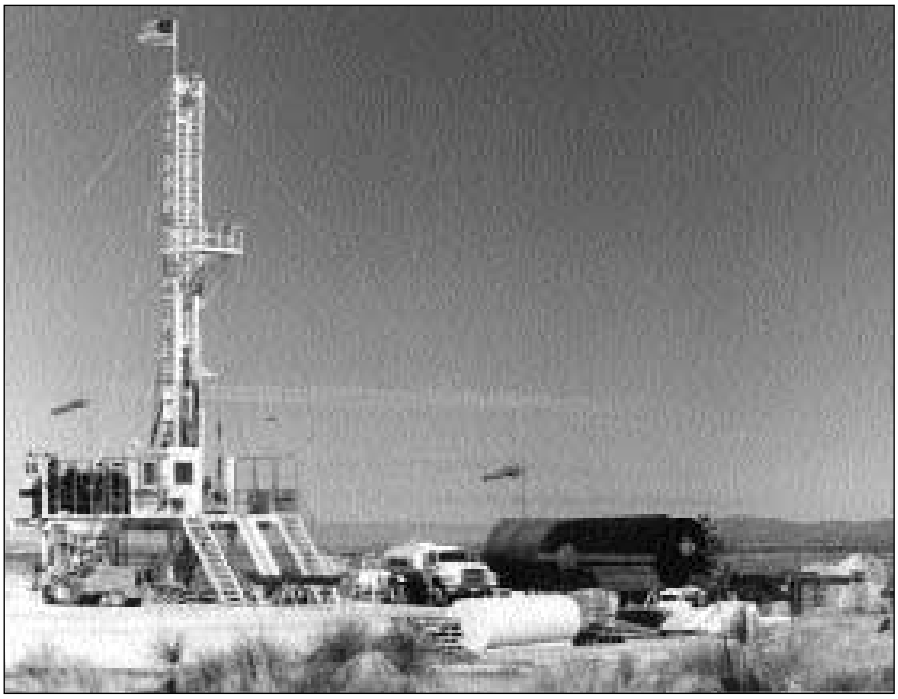
estimates that these four geothermally heated greenhouses represent a capital investment of more than $10 million, generating at least $14 million in annual sales and about 270 jobs.

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 10 provides information on the various direct-use geothermal applications in New Mexico, totaling more than 400,000 million BTUs per year of heat.

Large commercial-scale power plants of 1 megawatt (MW) or greater can generate electricity utilizing high-temperature geothermal resources—greater than 180 degrees C (356 degrees F)—but to date have not been constructed in the state. A geothermal resource adequate for supporting such a power plant is located in the Valles Caldera area in the Jemez Mountains. With geothermal binary power plants now able to utilize moderate-temperature resources, electricity generation at small commercial scale in the 100 kilowatt (kW) to 1 MW range is becoming cost-effective. Binary power plants are emission-free in converting the geothermally heated water to electricity through a heat exchanger, turbine, and generator. Small binary power plants have operated in New Mexico on a limited basis and appear to be most effective in meeting on-site electricity needs of businesses with geothermal direct-use applications.

Recent Developments

ECMD has facilitated promotional and technical information exchanges on geothermal energy through a variety of activities. ECMD held the first-ever New Mexico Geothermal Energy Conference in Albuquerque in April 2002, in partnership with U.S. Department of Energy (DOE) and Sandia National Laboratories (SNL), to provide information on New Mexico's geothermal resources and to explore mechanisms by which to encourage further development. In addition, ECMD and SWTDI secured two competitive DOE grants in recent years: $50,000 in 2002 for development of a Geothermal Information Clearinghouse in New Mexico and $38,000 in 2003 to attract businesses to utilize New Mexico's geothermal energy. ECMD continues to coordinate the efforts of the New Mexico Geothermal Energy Working Group, which was established in partnership with SNL under the auspices of DOE's *Geopowering the West* program; the group promotes the development and use of New Mexico's geothermal resources. SWTDI remains a leader in providing technical assistance and information for geothermal development in the state.



Continuous wire-line core drilling at well 45-5 to 3,961 feet depth at Fort Bliss, Otero County, New Mexico. (Source: Jim Witcher, SWTDI)

HYDROPOWER

New Mexico's hydroelectric capacity is 78.4 megawatts from nine plants: Navajo Reservoir (30MW), Elephant Butte (24.3 MW), Abiquiu (15MW), El Vado (8.8 MW), Farmington (200 kW), Alamogordo (60 kW), Raton (30kW), Cloudcroft (15 kW), Reserve (10kW). Although not a substantial portion of the state's total generating capacity, hydropower could play a more significant role in meeting site-specific needs.

Many undeveloped small hydropower sites exist in New Mexico, including river sites and existing dams, but numerous constraints limit the potential. These constraints include financing, multiple-use issues, regulatory barriers, economic issues, and environmental impacts. Details about existing plants and potential sites can be found in earlier issues of the Annual Resources Report.