

NEW MEXICO'S ENERGY, PRESENT AND FUTURE

**Policy, Production, Economics,
and the Environment**

Brian S. Brister and L. Greer Price, Editors

DECISION-MAKERS
FIELD CONFERENCE 2002
San Juan Basin



NEW MEXICO'S ENERGY, PRESENT AND FUTURE

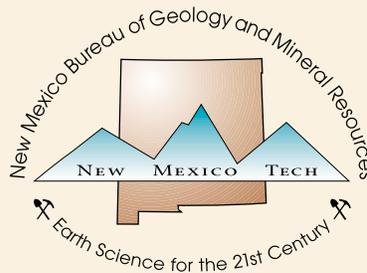
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A Division of New Mexico Institute of Mining and Technology
2002

New Mexico's Energy, Present and Future: Policy, Production, Economics, and the Environment

Brian S. Brister and L. Greer Price, Editors

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Preface

This book was designed to accompany the second annual Decision-Maker's Field Conference in May 2002. The purpose of this year's conference is to provide the decision makers of New Mexico with an overview of the issues affecting the present and future of energy in New Mexico. Never has the topic of energy been more timely, uppermost in the minds of the American people and of those who shape policies that affect us all. New Mexico, with some of the most significant energy reserves in the lower forty-eight states, has been and will continue to be a major player in the energy future of this country. The focus of this guidebook is on the northwest portion of the state known as the San Juan Basin. This area for years has played a vital role in the energy business and overall economy of New Mexico. There is no question that the San Juan Basin will continue to play an important role in the foreseeable future, in spite of the ever-changing social, political, and technological structure of our society.

The broad topics represented by each of the five chapters were selected to provide a fundamental look at how energy is produced and made available in New Mexico. Each of the articles within those chapters was chosen to provide important background material, to provide a look at how things operate today, or to offer some insight into the promises and challenges that lie ahead. Fossil fuels remain the cornerstone of energy supply in the short and near term, and they must be managed effectively. Renewable/alternative energy resources (solar, wind, geothermal, biomass) have the potential to make significant contributions, as well, in meeting the long term needs of our state, the nation, and the world.

In the process of putting together the conference and the guidebook, we spoke with citizens, scientists, government regulators, and industry workers—all of whom recognized the advantages of improving our ability to be more efficient, practice conservation, and reduce our footprint on the environment at every step of the process, from production, processing, and generation, through distribution and consumption. There is no question that one of the challenges that lies before us is the need to balance our growing needs with the growing importance placed on the quality of our environment.

The articles were written by authors who are both knowledgeable in their field and capable of communi-

cating these complex issues to the public. The overall balance of the volume was determined in part by authors who were willing to write for us on a tight schedule. Within this limitation, we've tried to achieve a balance. We gratefully acknowledge the hard work of the authors and agencies who worked closely with us to bring this information to the public. We are grateful also to the many others—photographers, cartographers, designers, and so forth—who helped us make this book an effective tool.

We hope that the book will have a life and a value far beyond the three days of the conference. We intended it to serve as something of a reference, but it is in no way the final word. We see it, rather, as a good start. It was our overall intention to pose important questions rather than to provide definitive answers. We cannot frankly imagine a time when energy will not be a significant issue for all of us, in New Mexico and throughout the country. If this book is a small step in moving from discussion to some resolution of the many challenges that face us, then we will have achieved our goal.

-The Editors

An Introduction from the State Geologist

Peter Scholle, *New Mexico Bureau of Geology and Mineral Resources*

Welcome to the second annual Decision-Makers Field Conference. This year we are focusing on New Mexico's energy resources and how they're used, today and in the future. The conference is organized by the New Mexico Bureau of Geology & Mineral Resources in conjunction with many partners, including several state and federal agencies, tribal governments, and private companies (listed in the front of this publication). We are grateful to those partners for their year-long support in planning, organizing, financing, and conducting this conference. We are equally grateful to the presenters who have prepared long and hard and, in many cases, traveled far in order to give you their insights into the complex energy issues that face this state.

The major rationale for these conferences is to offer information to legislators, government agency officials, and others in positions of influence within the state; to provide a hands-on look at how things work now; to investigate the scientific and technical constraints on resource discovery and exploitation; and to discuss possible scenarios for the future and what it would take to make them happen. Other purposes include fostering collaboration within the scientific community of the state, developing interactions between state agencies, introducing political leaders to scientists who can help to advise on future legislation, and producing a document (this volume) that can stand as a broadly understandable background piece for future discussions. The purpose of the conference is not to lobby for specific legislation. Participants have been asked to be as fair and impartial as possible, and we have taken great pains to produce a conference that provides a balance between competing points of view while retaining strong individual perspectives.

Over the next few days, we will deal with a range of topics associated with exploration and production of conventional fossil fuels, as well as issues associated with refining, transporting, and generating energy from these materials. We will explore ways to stimulate energy production (and thus increase state revenues) and examine some of the environmental consequences such strategies may pose. We will also take a look at realistic alternatives to conventional energy development. These are not black and white alternatives. Our energy future will almost certainly consist

of a mix of solutions, and the nature of the mix will be influenced by your decisions, and probably by decisions and actions that take place far from New Mexico. Let's briefly examine some of the larger issues of the coming energy debate.

The global community currently is wrestling with major energy-related problems: potential climate change and other environmental issues, political instability in the Middle East and its impact on oil supplies, and the frightening lack of security of international and domestic oil and gas supply and transport. The United States, as the world's largest single energy consumer, is in the process of formulating its own broad energy policy, the first serious effort at such a plan since the late 1970s. New Mexico will certainly be affected by such global and national policies (and it has substantial influence in the formulation of such policy, thanks to New Mexico's federal delegation). Within the context of broader energy legislation, however, New Mexico can forge its own policies and directions to a degree probably unmatched by any other state. We have a wide range of local options because we are blessed with a remarkable diversity of energy resources, both conventional and unconventional. New Mexico is fifth among all states in oil production (and fourth in proven oil reserves), second in natural gas production (second also in proven gas reserves), tenth in proven coal reserves (third in recoverable coal reserves from currently producing mines), second in total uranium reserves (and first in high-grade reserves), among the top three states in solar power potential (probably second only to Arizona; Fig. 1), has excellent wind power potential (especially in the High Plains areas of eastern New Mexico; Fig. 2), has substantial geothermal resources (especially in the area of relatively low-temperature resources), and excellent biomass generation potential (particularly given the state's extensive forests and feedlot/dairy operations). In addition, New Mexico is home to two national laboratories and several universities that conduct cutting-edge fossil-fuel and renewable-energy research.

Despite this broad spectrum of opportunities, New Mexico's energy options are not without difficulties. Intelligent use of our energy resources requires a detailed understanding of complex issues and careful

planning. Currently, both the state and the nation are largely dependent on fossil fuels. In New Mexico, petroleum and coal are not only the predominant “fuels of choice,” they are mainstays of our economy. Petroleum production alone accounts directly for 23,000 jobs along with 20% of the revenues in the state’s general fund and 95% of permanent fund income. Coal mining also supplies substantial revenues and more than 1,500 jobs at six mines and is now the state’s largest non-energy extractive industry in terms of product value (at \$591 million in 1998). Conventional fossil-fuel energy production thus will and must remain a substantial part of New Mexico’s energy mix far into the foreseeable future.

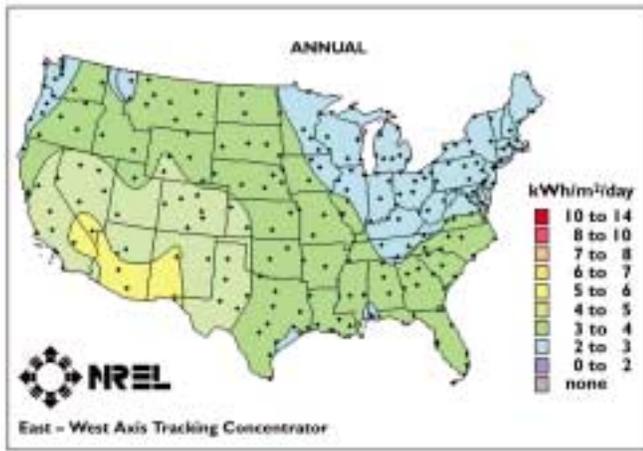


FIGURE 1 Average daily solar radiation per month.

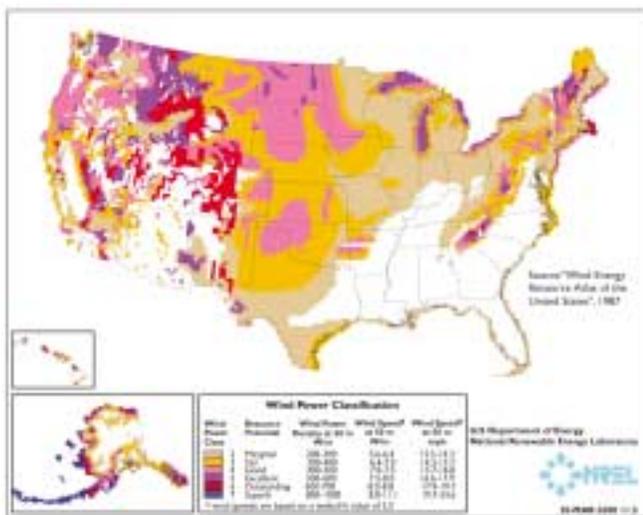


FIGURE 2 United States wind resource map.

At the same time, we must understand that fossil fuels are finite, nonrenewable resources. In the case of petroleum, most experts agree that we are irreversibly on the downhill side of the production curve, both as a nation and as a state. Figure 3 illustrates the national picture (using average daily production and consumption data). Petroleum production in the U. S. peaked in 1970 and has gradually declined since then to the point that current production is now barely above 1950 levels. That decline took place despite major advances in drilling technology (especially horizontal drilling), exploration methods (especially 3-D seismic imaging), and secondary/tertiary recovery techniques. Figure 3 also shows that U. S. petroleum consumption, unlike domestic production, has nearly quadrupled in the past 50 years (with the only substantial decline resulting from conservation measures instituted in the 5-year period following the Middle East oil crisis of 1976). As a result of the growing gap between domestic production and consumption, the United States now imports about 60% of the petroleum it consumes.

New Mexico’s petroleum production record is similar to that of the nation. Figures 4 and 5 show annual oil and natural gas production in New Mexico from 1924 onward. Oil production peaked in 1969 and has subsequently declined roughly to 1950 output levels. Natural gas supplies, on the other hand, continue to grow, and were boosted dramatically in the 1990s with the addition of coalbed methane output, which now accounts for nearly 25% of the state’s total natural gas production. The rest of the natural gas productivity increase comes less from the discovery of new fields than from the extraction of additional resources from prior discoveries. Although New Mexico’s gas production is at an all time high, natural gas is also a finite resource that must eventually peak and decline. Predictions of when the peak and decline will come vary substantially, but most envision at best a few decades at maximal production levels.

There are three observations that I would like to draw from these trends of petroleum production. First, the United States will not regain “energy independence” or much national security if it relies on oil and natural gas for its predominant energy supply. The decline in oil production, in particular, is unlikely to be reversed, regardless of the national policies we pursue, and it is difficult (or in some cases impossible) to provide adequate security for our extensive oil fields, refineries, and pipelines in this era of potential terrorism. However, if we wish to extend the life of

our oil- and gas-based economy, and we almost certainly do, we will need to provide opportunities for new and unconventional discoveries. That will entail allowing exploration in areas previously unexplored or under-explored, and those access decisions will undoubtedly be complicated by environmental concerns in many areas. In addition, we will probably need to provide incentives for the development of new technologies and the application of those technologies by the generally smaller companies that now dominate domestic petroleum exploration. If we value the energy independence and jobs provided by this industry, then we may need to share in the high costs of finding the “last drops of oil.”

Second, we should view the oil and gas deposits

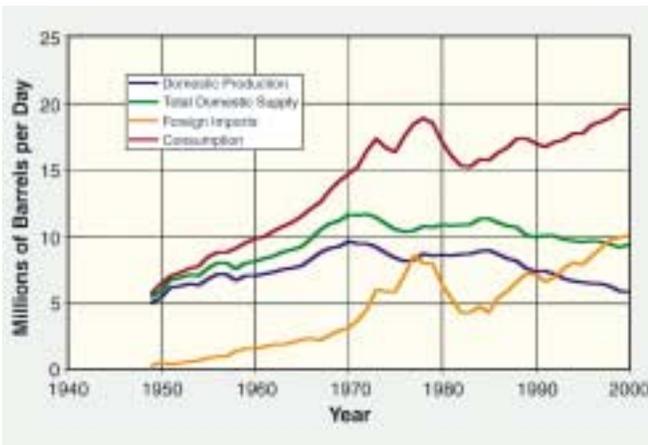


FIGURE 3 U.S. petroleum supply versus consumption.

that are still to be produced in New Mexico not simply as a resource to be exploited, but as a lifeline to help us through a transition to a different energy future. Oil, natural gas, and even the more extensive coal supplies will eventually be depleted, and we must be prepared for that day, with a mix of other energy sources: wind, solar, geothermal, and perhaps nuclear, all of which are available to New Mexicans. Energy conservation measures, including more fuel-efficient vehicles, better mass transit, and more energy-efficient homes, can extend the length of the transition period and decrease the amount of alternative energy capacity that must be created. Nonetheless, fossil fuels will remain very important even after a transition to renewables, especially to provide backup power at peak demand times or other times when renewables fail to generate sufficient power. Conservation can also allow us to save fossil “fuels” for non-fuel uses such as fertilizers and plastics (future generations no doubt will look

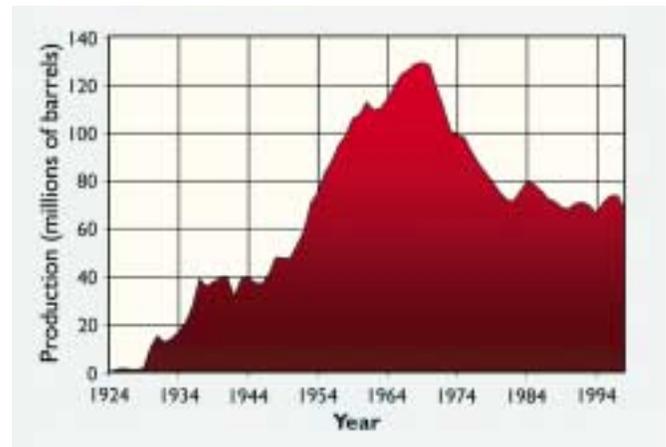


FIGURE 4 New Mexico's annual oil production, 1924-98.

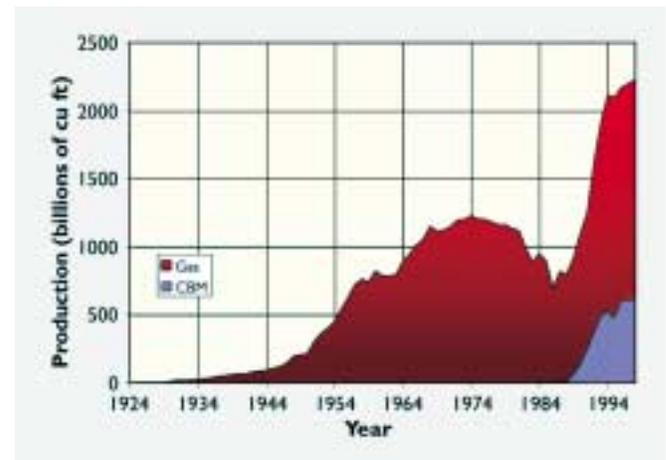


FIGURE 5 New Mexico's annual gas production 1924-98.

back with disbelief that we burned these precious materials simply to generate energy).

Third, it is important for us to recognize that the transition to a different energy future has already started. Look around! Small-scale solar applications abound, wind farms are being developed, and geothermally heated facilities are now a significant component of the economy in New Mexico's bootheel region. All three major American carmakers have announced that they will release hybrid energy or fuel cell cars within the next few years. And perhaps most significantly, the cost of generating power from solar and wind facilities is now quite close to being competitive with fossil-fuel-generated energy. This, combined with the environmental benefits of renewability, the lack of emissions, and the relative security of supply, means that

alternative energy is here to stay. Given its level of alternative energy potential and the quality of its energy researchers, New Mexico certainly could become a national leader in converting to more modern forms of energy generation. Indeed, it could also be a leader in manufacturing and marketing the technologies needed for the transition to the future. Whether it should and whether it will is up to you. The decisions you make, the priorities you establish, and the incentives or disincentives you put into place will determine if we move passively or aggressively into the future.

As you ponder these choices, I urge you to take a look at Denmark as a role model. This small nation, with a population of about five million and a land area only one seventh that of New Mexico's, has Europe's most robust economy while generating its energy through a mix of wind power, cogeneration at domestic waste incinerators, and conventional oil and natural gas. It has encouraged private investment for construction of wind facilities through tax incentives and by allowing investors to sell excess power back to the national grid. More importantly, this tiny nation now is a leader in wind energy research and produces more than 75% of the world's large power-generating wind turbines. It has turned a national need into a national resource through an interesting mix of vision, education, devotion to environmental principles, and aggressive manufacturing and marketing. By the way, it did this while maintaining a thriving petroleum industry—indeed, Denmark is now a net oil-exporting nation. There is nothing in this story, however, that New Mexico could not match!

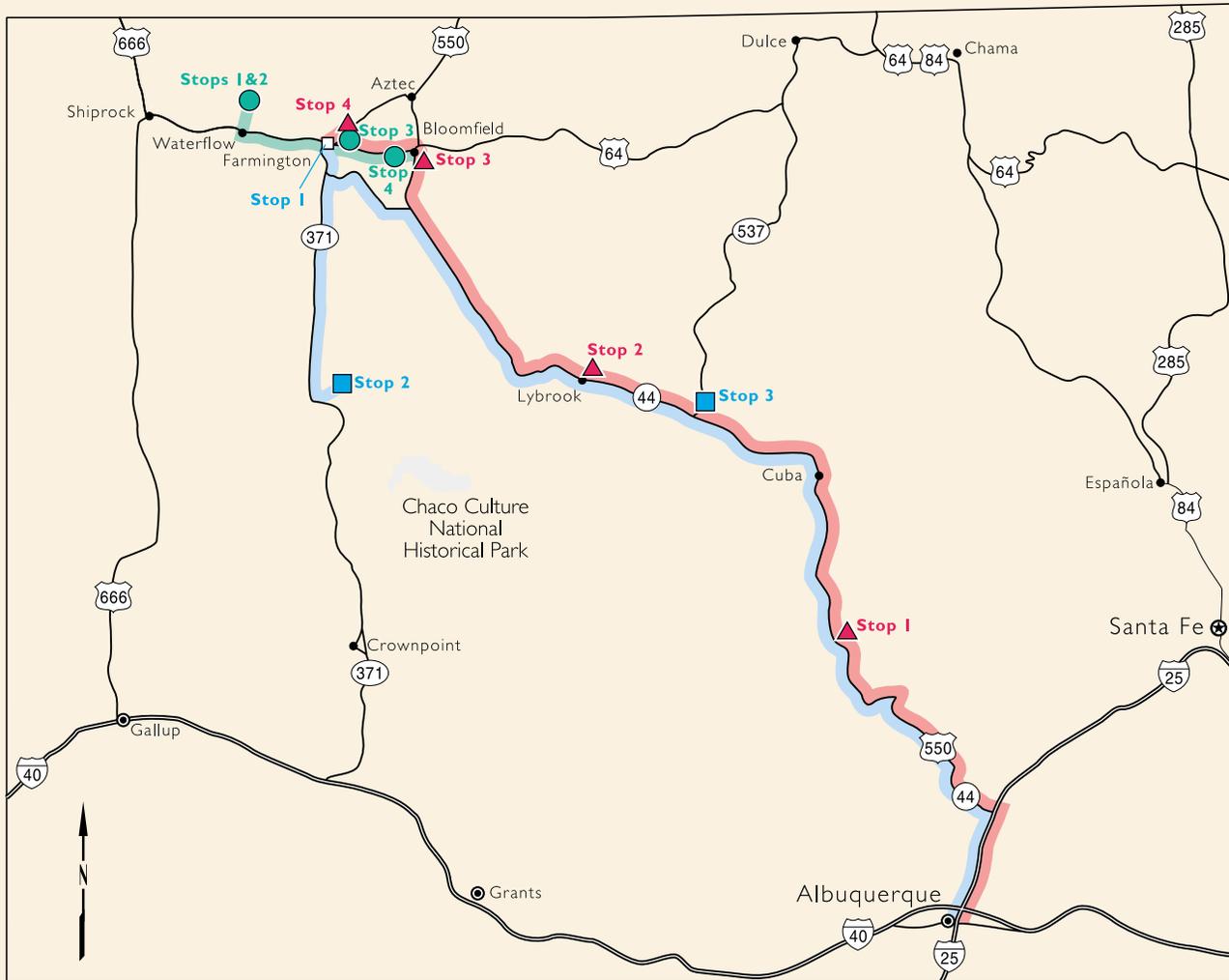
Clearly our work is cut out for us. I hope that this conference will supply you with the information, the concepts, and the contacts needed to make wise and informed decisions in coming years. Together we can achieve the needed vision, and hopefully an understanding of how to deal with the stresses that inevitably accompany such profound societal changes.

THE FIELD CONFERENCE

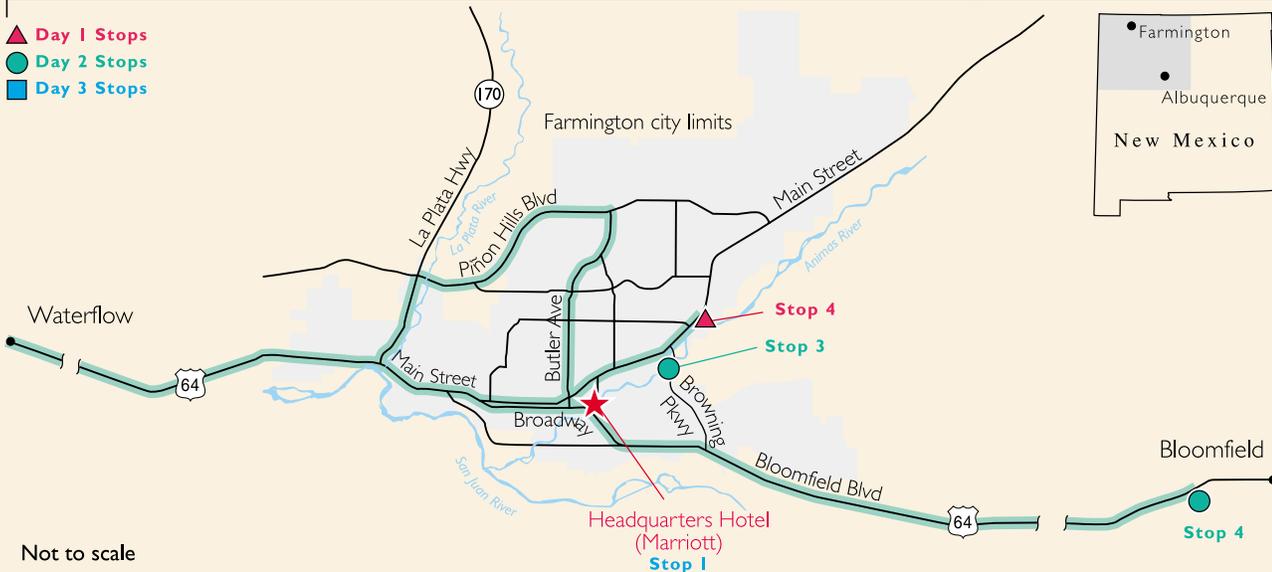
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Field Conference Routes



- ▲ Day 1 Stops
- Day 2 Stops
- Day 3 Stops



Not to scale

New Mexicans enjoy abundant and relatively inexpensive fossil fuel energy resources in the form of coal, oil, and natural gas. Yet such resources are finite and have cost trade-offs in terms of environmental degradation and global security issues. New technologies are being developed to use these resources more efficiently, particularly in the form of fuel cells that harness electricity-producing chemical reactions and involve a variety of fuels derived from both fossil and biomass (derived from plants, animals, and bacteria) sources.

There is a growing niche for renewable energy resources that don't require fuel to generate power. Hydroelectric power generation is a long-established method of harnessing natural energy; this is currently our most important form of renewable electrical power. Although our arid climate limits the potential for hydroelectric power, New Mexico is well situated to take advantage of other renewable forms of energy, particularly wind power for commercial-scale applications. On a small scale, solar energy in particular can bring power and heat to otherwise underserved remote locations. Geothermal heating has gained a foothold in New Mexico for agricultural purposes. Several factors will make these energy sources commercially viable in New Mexico in the near future. These include a strong desire on the part of the public to reduce pollution, ongoing improvements in cost and functionality through continued research and development, and interest on the part of decision makers to find ways to stimulate the practical application of these energy resources.

This session focuses on recent progress in the development of renewable energy resources. It will conclude with a discussion of what decision makers might do to encourage implementation of these new technologies.

PRESENTATIONS

- Renewable Energy in New Mexico: Current Status and Future Outlook
Chris Wentz,* *Energy Conservation and Management, EMNRD*
- Indian Pueblo Cultural Center Photovoltaic Project
Dave Melton,* *Diversified Systems Manufacturing LLC*
- The Promise of Solar Energy
Carl Bickford, *San Juan College*
- Practical Uses of New Mexico's Geothermal Resources
James Witcher,* *Southwest Technology Development Institute, New Mexico State University*
- Recent Advances in Fuel Cell Research
Charryl Berger, *Los Alamos National Laboratory*
- Net Metering in New Mexico
Patrick Scharff,* *Public Service Company of New Mexico*
- Incentives for Stimulating Development of Renewable Resources
Ben Luce,* *New Mexico Solar Energy Association*

* Indicates that the speaker is an author of a paper in this volume

Wednesday Evening May 8, 2002

OPENING SESSION

ADVANCES IN RENEWABLE ENERGY RESOURCES

Marriott Courtyard Hotel, Albuquerque



This 600-kilowatt wind turbine near Clovis is the only commercial wind turbine in New Mexico.

Day 1 Thursday Morning May 9, 2002

STOP 1 AN INTRODUCTION TO SAN JUAN BASIN ENERGY RESOURCES

Holy Ghost Spring Overlook, Jemez Pueblo

This stop overlooks Holy Ghost Spring on lands of the Jemez Pueblo, some 50 miles from Albuquerque on NM-550. From this vantage point, a 360° view provides the perfect setting for discussing the fundamental geology that influences the types and amounts of earth-based energy resources enriching this corner of New Mexico. Sparse dry-land vegetation dots the landscape, yet the tiny treed oasis of Holy Ghost Spring reminds us of the importance of the nearby Nacimiento Range and other highlands surrounding the San Juan Basin as the sources of recharge to the aquifers and waterways of the region. Water resources here and elsewhere in New Mexico are limited. This limits the industrial, agricultural, and other activities that depend upon a reliable and abundant water supply. Yet the very fact that water takes up residence in the warm earth provides geothermal resources that are being tapped on the Jemez Pueblo for heating purposes.

At the overlook, as at other sites around the margins of the San Juan Basin, rock formations tilt toward the basin center. These are the same rocks that contain oil, natural gas, and coal in the basin subsurface. Years of geologic study and insights gained through mapping, prospecting, and drilling have provided a thorough understanding of the reserve characteristics of the San Juan Basin. With careful planning, improved technology, and favorable economic conditions, the basin will continue to be developed as one of the nation's most important natural gas-producing basins, and New Mexico's export "cash cow," for decades to come. The potential for the San Juan Basin to provide long-term, coal-based electrical power to the Southwest is perhaps even greater.

PRESENTATIONS

- Orientation and Overview of San Juan Basin Geology
Brian Brister,* *New Mexico Bureau of Geology and Mineral Resources.*
- Oil & Gas Natural Resources
Ron Broadhead,* *New Mexico Bureau of Geology and Mineral Resources*
- Foreseeable Development of San Juan Basin Oil and Gas Reserves
Tom Engler,* *New Mexico Tech*
- Jemez Pueblo Geothermal Project
James Witcher,* *Southwest Technology Development Institute, New Mexico State University*
- Jemez Pueblo Energy Perspective
Jemez Pueblo Representative

Lybrook, New Mexico, is on the southern edge of the main oil- and natural gas- producing part of the San Juan Basin, about 112 miles from Albuquerque on NM-550. As in many Rocky Mountain basins, the basin margin fields tend to be oil prone, whereas the deep basin fields tend to produce natural gas. Classic oil field pumpjacks slowly bob up and down around Lybrook, extracting the last remains of the oil from reservoirs long past peak production. Yet not far to the north, northwest, and northeast, the San Juan Basin is just reaching its prime in terms of natural gas production.

Oil and gas fields require substantial infrastructure before the product can reach a market. As a field is developed, there is an increasing demand for well sites, processing facilities, and road and pipeline right-of-ways. Unlike oil, natural gas cannot be trucked; it depends upon a system of pipelines for transport. The history of development of the extensive gas reserves in the San Juan Basin is closely tied to the “take-away” capacity of pipelines to move the gas out of the basin. “Booms” in development take place as take-away capacity expands with new pipeline construction, generally in response to a greater demand in major markets like California.

The plumbing system of natural gas infrastructure is technologically complex. Pressurization is required to move the gas. Safety and market standards require that the gas be a certain quality. Facilities like the Williams Companies gas plant at Lybrook exist to collect the gas and strip it of undesirable (but often economically valuable) components for interstate pipeline transport. Liquefied petroleum gas is stripped, bottled, transported, and sold as fuel. Natural gasoline becomes a refinery feedstock. At some plants, undesirable components like nitrogen and carbon dioxide may be removed. The resulting nearly pure methane, the blood of the arterial system, is the environmentally friendlier fossil fuel of choice for the next decade. The health of the aging artery system is of great concern to the public welfare.

PRESENTATIONS

- Tour of Lybrook Gas Plant
Grant Hammer, *Williams Energy Services*
- Orientation and Introduction to Natural Gas Infrastructure
Brian Brister,* *New Mexico Bureau of Geology and Mineral Resources*
- Pipeline Safety in New Mexico
Rory McMinn, *Public Regulation Commission*
- Pipeline Security
Dipen Sinha, *Los Alamos National Laboratories*

Day 1 Thursday Afternoon May 9, 2002

STOP 2 SAN JUAN BASIN NATURAL GAS INFRASTRUCTURE

Williams Gas Plant & Environs, Lybrook



Williams gas plant at Lybrook

Day 1 Thursday Afternoon May 9, 2002

STOP 3 ENERGY PRODUCTION IN THE CONTEXT OF MULTIPLE LAND USE

Giant Refinery in Bloomfield

Bloomfield may be the model for how industrial activity can build a thriving community. Standing atop the bluff on the southern bank of the San Juan River, one can see fishermen harvesting dinner from the cool and clear stream. The river is a vitally important water supply to users in New Mexico and many points downstream. To the right on the same bluff, an oil refinery produces gasoline and diesel fuel for distribution in New Mexico and Arizona. The refinery also uses its share of the river's water. Its proximity to the river naturally causes concern because of potential environmental impacts. Across the river, one sees a tree-shaded park complete with baseball diamonds and natural gas wells. Somehow, these disparate elements seem to fit together in this community; there are more than 40 wells scattered throughout the city limits, and many people work in the petroleum industry. Bloomfield is a central gathering point for several pipelines. Four plants visible on the far northern outskirts of town process natural gas or compress it for the long trip to California.

We are standing in a gravel pit. Gravel is one of the resources required in nearly every operation visible from this point: in construction, as aggregate in cement, as road base, and many more. The successful development of energy resources invariably requires the development of other natural resources, as well.

In nearly every direction from town, much of the land is held in the public trust by the Bureau of Land Management. That agency's job is a continual struggle with the two-headed monster of maximizing energy production for the public good of the present generation, while protecting the land for future generations. Competing uses for these lands today range from drilling and mining to ranching and farming. The scenic "vista scape" has incredible value for locals and tourists, and the raw, sparsely populated landscape is home to wildlife. This is an ideal site to ponder the benefits and tradeoffs of energy resource development.

PRESENTATIONS

- Bus Tour of Giant Industries Refinery in Bloomfield
- Orientation and Introduction
Brian Brister, *New Mexico Bureau of Geology and Mineral Resources*
- Groundwater Protection vs. Remediation
William Olson,* *Oil Conservation Division Environment Bureau, EMNRD*
- Energy Production in Context of Multiple Land Uses
Steve Henke,* *U. S. Bureau of Land Management*
- Energy Issues and Conflicts of Rural New Mexico
Tweeti Blancett, *farming and ranching advocate*
- Environmental Considerations
Jim Hannan, *Sierra Club*
- Consequences of Regulatory Decisions on Land Access for Oil and Gas Development
Robert Gallagher, *New Mexico Oil and Gas Association*

The Farmington Museum, on the banks of the Animas River and a short distance upstream of the day's final destination, is the newly constructed pride of the city. It displays memorabilia of the city's past and emphasizes the role of the development of the energy industry in the city's past, present, and future. Although rich in natural gas production and nearby coal-generated electric power generation, Farmington is partially supplied by two hydroelectric generation facilities. One is only a few hundred yards from our headquarters hotel on the banks of the Animas River, and the other is at Navajo Dam on the San Juan River.

PRESENTATIONS

- Introduction
Teri Conrad, *Education Consultant representing BHP Billiton*
- Welcome; The Importance of Extractive Industries to Farmington
Bill Standley, *Mayor of the City of Farmington*
- San Juan Community College Renewable Resources Demonstration
Carl Bickford, *San Juan College*

Day 1 Thursday Afternoon May 9, 2002

STOP 4 FARMINGTON MUSEUM



The Farmington Museum.

New techniques for advanced energy efficiency, chiefly through integrative design, can make very large savings cost less than small or no savings, whether in buildings, industry, or vehicles. These energy productivity techniques can form a balanced portfolio and an inherently secure energy system when combined with innovative supply technologies that provide the right quality and scale of energy for the task. Technological discontinuities can dramatically shift the energy system toward decentralized production, diverse and sustainable sources, a climate-safe hydrogen economy, and new means of implementation.

Tonight's speaker is sponsored by
Public Service Company of New Mexico

Day 1 Thursday Evening May 9, 2002

KEYNOTE SPEAKER



Amory Lovins
Rocky Mountain Institute

THE COMING ENERGY SURPRISES: INTEGRATING ADVANCED EFFICIENCY WITH SECURE SUPPLY

Marriott Courtyard Hotel

Day 2 Friday Morning May 10, 2002

STOP 1 COAL MINING IN NEW MEXICO

The San Juan Coal Mine, Waterflow

The focus of this morning's stops is coal mining and coal-fired electric power generation. These two industries are intimately linked in the region. The thick Fruitland Formation coal on the San Juan Basin's western flank cannot be exported to distant power plants because of the lack of railway infrastructure. So-called "mine-mouth" power plants have evolved to use the resource where it is found. This relationship demands the existence of extensive coal reserves that can be mined at foreseeable production rates and relies upon long-term price and regulatory stability of the electric power industry. For these reasons, "legacy" power generation methods could remain with us for decades to come. However, this nation's coal reserves are enormous; coal-powered generation could continue for centuries. The continued development of mining and power generation technology is critical to our prosperity, based on current projections of future use of electric power. No less critical is our responsibility for the environment inherited by future generations.

The San Juan mine is undergoing a transition from surface to underground mining. Surface mining requires stripping huge volumes of overburden from above the coal and redistributing the spoil into areas to be reclaimed. Reclamation and mining occur simultaneously at such an operation. The mine is situated along the western Hogback monocline where the Fruitland coal dips eastward into the basin. The mining operation migrated eastward, deeper into the basin until the overburden became too thick for removal. Now the mine is gearing up for continuous underground mining. This avoids the problems of contamination of surface-mined coal with the non-coal overburden and inferior coal seams. It also minimizes surface disturbance, the need for reclamation, and some of the environmental consequences. The underground operation will significantly extend the production life of this mine, and it will improve the quality of coal consumed.

PRESENTATIONS

- Bus Tour of the San Juan Mine
James Luther, *BHP Billiton*
- Orientation and Introduction to Coal Mining in New Mexico
Gretchen Hoffman, * *New Mexico Bureau of Geology and Mineral Resources*
- Production and Economic Issues
Frank Dayish, *BHP Billiton*
- Regulatory Agencies Involved and Regulation
James O'Hara, * *Mining and Minerals Division, EMNRD*
- Innovative Practices in Mine Reclamation and Air Quality
James Luther, *BHP Billiton*
- Navajo Nation Role in Coal Mining in the San Juan Basin
Arvin Trujillo, *Navajo Nation*

Fifty-six percent of the electricity produced nationwide is generated from the combustion of coal. In New Mexico the percentage is much greater (88%). Nuclear, natural gas, hydroelectric, and fuel oils play a larger role in other regions of the country, but coal remains the dominant source for electricity because of its low cost and abundance. Half of the electricity produced in New Mexico is consumed in other states, including Arizona and California. Of the total energy consumed within the state, including electricity, gasoline for cars, propane for heating, and petroleum products for industrial uses, 46% is from coal in the form of electricity.

Generating power by coal combustion results in byproducts and emissions that are regulated by standards set by the U.S. Environmental Protection Agency (EPA). Although as much as 99% of fly ash can be removed from the flue gas by electrostatic precipitators, other emissions, such as sulfur dioxide, nitrogen dioxide, and carbon dioxide have adverse effects on the environment. Many people feel that existing standards are not sufficient to do what they were designed to do: keep air clean. New “clean coal technology” hopes to address these issues by raising the bar on source emissions and ambient air quality standards.

Power generating utilities typically own the transmission lines and distribution systems in a regional monopoly. The Electric Utility Restructuring Act passed by the legislature would have changed the face of the industry, but as a reaction to a recent power crisis in California, 2001 legislation delayed this action. The status of restructuring in New Mexico and transmission issues are currently pressing topics worthy of the continued attention of decision makers.

PRESENTATIONS

- Bus Tour of San Juan Generating Station
James Ray, *Public Service Company of New Mexico*
- Welcome
Russell Huffman, *Public Service Company of New Mexico*
- Orientation and Introduction
Gretchen Hoffman, *New Mexico Bureau of Geology and Mineral Resources*
- Raising the Bar: Continuous Improvement at San Juan Generating Station
Pat Goodman,* *Public Service Company of New Mexico*
- Air Quality and the Clean Air Act Amendment
Sandra Ely,* *New Mexico Environment Department—Air Quality Bureau*
- Transportation and Powerline Issues
Lynda Lovejoy, *Public Regulatory Commission*
- Deregulation: Status Report
Ernie C’de Baca,* *Public Service Company of New Mexico*
- Closing the Gap Between Policy and Science
Mark Sardella, *Southwestern Energy Institute*

Day 2 Friday Morning May 10, 2002

STOP 2 COAL-GENERATED ELECTRIC POWER

The San Juan Generating Station, Waterflow



Public Service Company of New Mexico's San Juan Generating Station, north of Waterflow.

Day 2 Friday Afternoon May 10, 2002

STOP 3 URBAN NATURAL GAS PRODUCTION

Animas Park, Farmington

Farmington, New Mexico, spans an area of some 25 square miles and has a population of nearly 45,000 people. The city is underlain by natural gas reservoirs including the Dakota Sandstone, Pictured Cliffs Sandstone, and Fruitland Formation coal and sandstone. Gas production from 80 wells within the city currently totals more than 5 billion cubic feet per year with a current value of approximately \$13.5 million (\$2.70 per thousand cubic feet). When so many people are in proximity to such industrial activity, there are naturally concerns about safety. Yet the city and gas operators have managed to find ways to coexist.

A variety of methods are being employed by both parties to minimize disturbances. Operators have installed noise-reducing equipment and structures. Many wells are landscaped to blend into their surroundings, some in park-like settings. Tanks with added leak protection may be hidden; others are decoratively painted where visible. The city has acted to reduce excessive truck hauling, particularly for those wells that naturally produce thousands of gallons of water per day, by accepting and managing produced water in the city sewage system. There is an ongoing education program designed to prevent accidents caused by curious youth.

This stop is at a well located within Animas Park on the city's Riverwalk, less than one mile from the headquarters hotel. This well is one that neither the city nor operators want to hide. Accompanied by historic oil field equipment, the well is labeled so that visitors can gain an understanding of the need and function of the equipment typically found at such sites, of the geology responsible for the gas reservoirs, and of the value to the community of such industrial activity.

PRESENTATIONS

- Orientation and Introduction
Brian Brister, *New Mexico Bureau of Geology and Mineral Resources*
- Gas Production in Farmington from Producer's Perspective
Tucker Bayless, *Independent Petroleum Association of New Mexico*
- Urban Production, Conflicts and Solutions
Frank Chavez,* *Oil Conservation Division, EMNRD*
- Produced-Water Filtration Research
Robert Lee, *New Mexico Petroleum Recovery Research Center*

Salmon Ruin is one of a number of structures that are part of a prehistoric cultural complex centered at Chaco Canyon. At this stop we will tour the ruin to gain a deeper understanding of the cultural and religious significance of this and similar archaeological sites in the San Juan Basin. Salmon Ruin is a county-funded archeological museum and contract research center where archaeologists on staff conduct contract archaeological surveys for drilling and exploration projects. The museum receives royalties from a gas well on site. A discussion session will examine how cultural sites and concepts interact with energy production, particularly from the viewpoints of the different state and federal agencies that oversee the regulation of historic preservation.

PRESENTATIONS

- Director's Tour of Salmon Ruin
Larry L. Baker, *Salmon Ruin Museum*
- Orientation and Introduction
James O'Hara, *Mining and Minerals Division, EMNRD*
- Partnerships to Conserve Cultural Resources
David Coss, *New Mexico State Land Office*
- Archaeology on Public Lands
James M. Copeland, *U. S. Bureau of Land Management*
- Historic Preservation Law
Jan Biella, *State Historic Preservation Office*
- The Zuni Pueblo Perspective on the Development of Energy Resources
Malcolm B. Bowekaty, *Zuni Pueblo*

Day 2 Friday Evening May 10, 2002

STOP 4 CULTURAL RESOURCES

Salmon Ruin, west of Bloomfield

Day 3 Saturday Morning May 11, 2002

STOP 1 SAN JUAN BASIN WATER RESOURCES

Farmington Riverwalk on the Animas River

Gasoline, natural gas, and electricity in New Mexico are readily accessible because they are inexpensive and abundant. Therefore, most New Mexicans take their energy resources for granted. Not so for water. The issues of adequate water availability and quality to a growing population are constantly being brought to our collective attention. Our continued prosperity, particularly in the short run, is more dependent upon water than energy. Water is critical to agriculture and industrial development, and limits the size and effectiveness of cities to serve their residents. As in the rest of the state, every drop is precious and not to be wasted, and essentially every drop is owned by someone.

Farmington, New Mexico is a city blessed with bank-full waterways but surrounded in all directions by the high and dry Colorado Plateau. Three rivers—the Animas, La Plata, and San Juan, born in the high San Juan Mountains of Colorado—come together within the city limits of Farmington, once called Junction City for the rivers' connection, later called Farmingtown (shortened to Farmington) due to the agricultural boon that resulted from abundant water in a fertile valley. Unlike most of New Mexico, all of Farmington's water supply comes directly from surface water, mostly from the Animas River. As in the rest of New Mexico, where the doctrine of prior appropriation is law, Farmington has limited rights to use river water. Many other users downstream have rights as well, determined by interstate compacts. This stop on the cottonwood-shaded banks of the Animas River provides an opportunity to review critical water issues brought to the attention of decision makers in last year's field conference in the Santa Fe region.

PRESENTATIONS

- Orientation and Introduction
Frank Titus, *New Mexico Bureau of Geology and Mineral Resources*
- Interstate Compacts
Norman Gaume, *New Mexico Interstate Stream Commission*
- San Juan Basin Groundwater Resources/Hydrogeology
William Stone,* *Los Alamos National Laboratories*
- Coal Water Rights
Paul Saavedra, *Water Rights Division, Office of the State Engineer*
- Water and Energy Development on the Navajo Reservation
Michael Benson, *Navajo Nation Department of Water Resources*

This stop is located at the Bisti badlands, about 35 miles south of Farmington, and is a good setting in which to discuss San Juan Basin “checkerboard” land ownership issues and to further discuss competing land use options. The stop literally straddles the fence separating an older reclaimed coal mine (Gateway mine) from the Bisti-De Na Zin Wilderness. Badlands topography is the scenically dramatic result of natural erosion of dry, poorly vegetated land and is a common landform of the San Juan Basin. Badlands are commonly formed where the Fruitland Formation, among others, are naturally exposed and eroded.

Fruitland coal beds are mined extensively at the San Juan, La Plata, and Navajo coal mines. The Gateway mine was a small-scale Fruitland coal strip mine on state land that trucked coal to the San Juan generating station in the 1980's. Although reclaimed to required standards, the Gateway mine's planed surface stands in stark contrast to the adjacent federally-administered wilderness area to the north, east, and south, and Navajo Reservation to the west.

The badlands of the Bisti/De-Na-Zin Wilderness were formally designated as such by Congress, first in 1984 in the San Juan Basin Wilderness Protection Act and later enlarged in 1996. The Wilderness is administered by the Bureau of Land Management and encompasses more than 27,000 acres. The coal reserves here extend far beyond the fence of the Gateway Mine, another instance in which energy resources are not always where we would prefer. The juxtaposition of the two at this spot offers a variety of technical and philosophical issues for decision makers to ponder.

PRESENTATIONS

- Orientation and Introduction
John Pfeil, *Mining and Minerals Division, EMNRD*
- Badlands Geomorphology
Dave Love,* *New Mexico Bureau of Geology and Mineral Resources*
- When Production Meets Wilderness
Doug Bland,* *Mining and Minerals Division, EMNRD*
- Economics of Multiple Land Ownership
Mark Hiles,* *New Mexico Mining Association*

Day 3 Saturday Morning May 11, 2002

STOP 2 WHEN PRODUCTION MEETS WILDERNESS

Bisti Badlands

Day 3 Saturday Afternoon May 11, 2002

STOP 3 ENERGY ISSUES OF JICARILLA APACHE TRIBE

Jicarilla Apache Reservation

The Jicarilla Apache Reservation extends over much of the eastern third of the San Juan Basin. Rich oil and natural gas reserves on the reservation were historically administered by federal agencies on behalf of the tribe. Over time, the tribe has become increasingly proactive in managing the energy production and related environmental impacts on the reservation. At this brief stop, we will hear from Thurman Velarde of the Jicarilla Apache Oil and Gas Administration, who will describe the tribe's efforts to become an important and active participant in the process of energy production in the region.

PRESENTATION

- Managing Oil and Gas Development on the Jicarilla Apache Reservation
Thurman Velarde, *Jicarilla Apache Oil and Gas Administration*