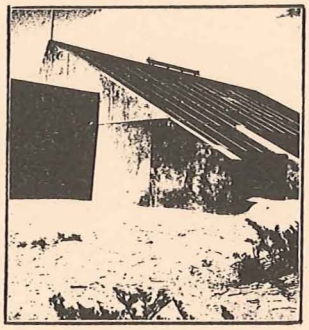
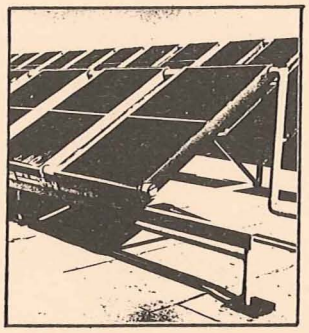
NEW MEXICO ENERGY INSTITUTE

at New Mexico State University

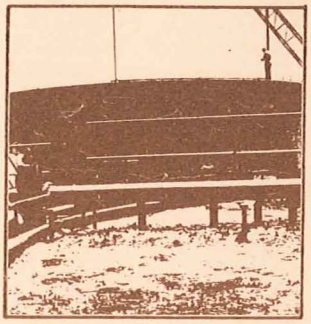
Research Program 1977

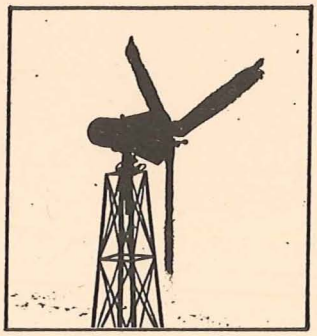
SOLAR





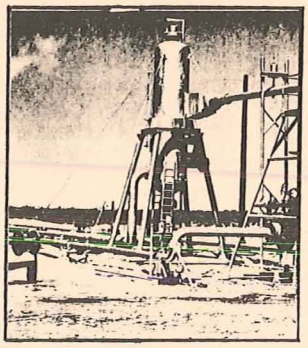
WASTE CONVERSION





WIND

GEOTHERMAL



new mexico solar energy institute

an introduction to the institute

On July 1, 1977, the New Mexico Solar Energy Institute opened its doors at Baldwin Hall on the campus of New Mexico State University in Las Cruces. Aiming at full operational capacity by October, the new organization directed by Dr. Robert L. San Martin found itself in a position to draw on an already solid tradition of solar studies and accomplishments.

Records dating from the 1940s show work on instrumentation to measure solar radiation and temperatures and on collector evaluation taking place in Las Cruces. In the 1950s area scientists fit a house with solar heating equipment. Solar evaporative studies which demonstrated, among other possible uses, the sun's potential for removing brine from industrial waste water spanned six years in the 1960s.

During three decades research on solar matters has spawned dozens of projects in Las Cruces as well as a significant body of publications. Generating new knowledge about concentrating and non-concentrating collectors has been an on-going concern throughout the period. Meanwhile, a number of investigations into the feasibility of using solar energy for such tasks as heating and cooling and irrigation pumping have also gone on. Another undertaking has actually produced a laboratory-efficient method of using solar energy to get hydrogen from water.

A pair of local projects have attracted worldwide attention since 1974. The New Mexico Department of Agriculture Building was authorized by the state legislature that year and was completed at a cost of $1.5 million in 1975. Using banks of solar collectors on the roof, the 25-hundred square foot structure provides comfortable year-round working conditions for some fifty people. Its innovative climate control system operates at costs which compare favorably with systems using only conventional energy supplies.

Also a Las Cruces landmark is the Collins Casa del Sol. This three-bedroom house is a solar demonstration facility which does double duty as a 2-thousand square foot laboratory for developing and testing new heating and cooling systems for residential use. Going up next door is a house which will take advantage of the heat of the day and the cool of the night in still another way.

Rather than use solar energy to run climate control equipment, the designers of the new house hope to maintain comfortable indoor temperatures by using a rooftop water reservoir as a thermal storage medium. According to the SKYTHERM system, heat gathered by day will warm the house during winter nights. In summer, falling overnight temperatures will turn the water into a coolant available for daytime use. Having the two solar houses side by

on solar issues.

Last but not least, Education and Information must handle on a routine basis requests from the public which can vary from the most elemental plea for explanations to queries about recent developments in high technology. To meet these requirements the division stocks reprints on solar topics, compiles booklets and fact sheets of its own and serves as the agent of referral for information not immediately available in pre-packaged form.

Analysis and Modeling is the division with the widest range of responsibilities, most of which revolve around the need to engage in short and long-term planning. It must study both the technical and the economic aspects of existing or pending solar capacities in order to pinpoint those technologies likely to benefit New Mexico most. Methods for implementing new alternatives must be the division's primary on-going concern.

It must also remain up to date about solar activities carried out under the auspices of local, state and federal government agencies as well as in the private sector. In short, the duty of Analysis and Modeling is to be aware of everything happening in the solar field. It is further obliged to make sure developments which seem likely to upgrade energy use patterns in New Mexico are brought to the attention of those in a position to apply them.

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how to use the services of nmsei

As previously stated, NMSEI is committed to serving all New Mexicans: rural and urban; farmers, workers, businesspeople and homemakers; dwellers in all of the state's many regions and climates. Those wishing to know more about particular solar topics and those who desire to learn about the institute itself are invited to make inquiries through: The New Mexico Solar Energy Institute; Division of Education and Information; Box 3EI; Las Cruces, New Mexico 88003.

PROJECTS GRANTED BY THE ENERGY RESOURCES BOARD -- July 21, 1977

1. "Comparison of Solar-Assisted Heat Pump with other Techniques Used in Solar Heating and Cooling."
   $34,590.00 -- NMSU #77-2201

2. "Economic Analysis of Small Scale Bioconversion Units in New Mexico."
   $19,910.00 -- NMSU #77-2202

3. "Active and Passive Seismic Studies of Geothermal Resources in New Mexico and Investigations of Earthquake Hazards to Geothermal Development."
   $50,000.00 -- NMSU #77-2203

4. "Development of Retrofit Energy Conservation and Solar Heating Systems."
   $ 8,000.00 -- NMSU #77-2104

5. "Dielectric Development for GaAs Solar Cells."
   $37,940.00 -- NMSU #77-2105

6. "Variable Speed Constant Frequency Voltage Generator (Alternator)."
   $47,515.00 -- NMSU #77-2106

7. "Solar Thermal Test Facilities Users Association."
   $50,000.00 -- NMSU #77-2207

NEW MEXICO ENERGY INSTITUTE

at New Mexico State University

Research Program 1977

New Mexico Energy Institute
at New Mexico State University
Box 3449
University Park, NM 88003

Dr. Robert L. San Martin, Director
Douglas W. Clark, Professional Writer
Eileen C. Sever, Secretary

February, 1977

The areas of responsibility designated to each Institute are as follows: Energy Institute at New Mexico State University -- solar, geothermal, wind and waste conversion; Energy Institute at the University of New Mexico -- conservation, nuclear, socio-economic and synfuels; Energy Institute at the New Mexico Institute of Mining and Technology -- coal, gas, oil and tertiary oil recovery.

All three Institutes are funded by the State of New Mexico through legislative appropriation.

NMEI at NMSU

Within each of its four areas of responsibility, the Energy Institute at New Mexico State University attempts to develop and promote projects which confront such aspects as assessment and resource availability, research, conceptual system analysis, component and subcomponent development, testing, complete system development, demonstrations, environmental and institutional problems, performance analysis of complete systems and commercialization, among others.

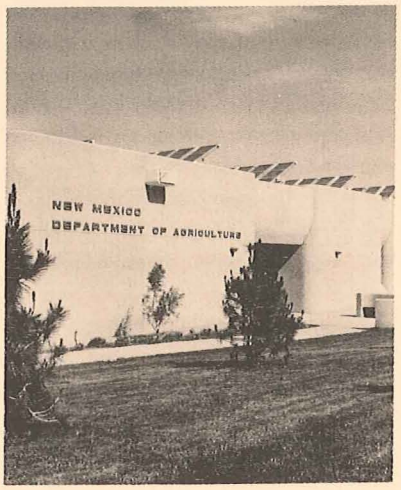
Any New Mexico institution of higher learning or nonprofit organization is eligible to participate in the Institute's program. Proposals to be considered are submitted directly to the Institute, where they are reviewed by the Institute's Technical Review Committee. Tentative recommendations are made at a joint meeting of the Research and Development Review Committee and the Institute Coordinating Council, with final approval and funding granted by the Energy Resources Board.

ADVISORY BOARD

RESEARCH PROGRAM

1977

SOLAR ENERGY



Instrumentation System for the New Mexico Department of Agriculture Solar Heated and Cooled Building

The New Mexico Department of Agriculture Solar Heated and Cooled Building, located on the campus of New Mexico State University, is the first solar heated and cooled building in the world. It therefore presents a unique opportunity for acquiring operational data needed by the scientific community, architects, building contractors and the general public. Under this project, the building has been instrumented and is being monitored to obtain such information. Through the computer controlled data acquisition system and the set of sensors installed, the information being accumulated will allow the system design to be evaluated and perfected, as well as enabling decisions to be made on system maintenance planning.

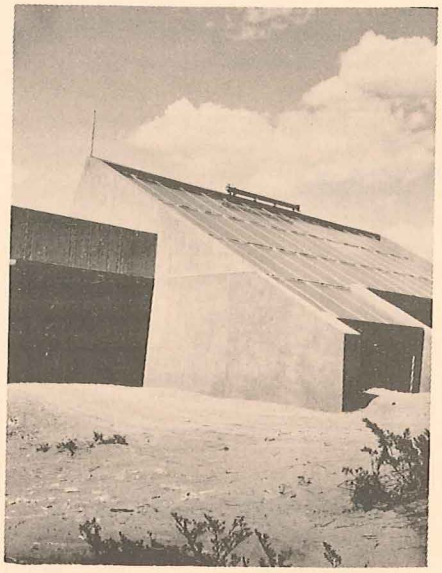
PRINCIPAL INVESTIGATOR: Dr. Robert L. San Martin, Department of Mechanical Engineering, New Mexico State University.

Solar Ponds for Residential Heating

Residential, commercial and industrial heating presently waste precious natural resources because there are few readily available sources of cheap, low-grade energy. One possible source of such energy may be solar ponds. With dark colored floors to improve absorption of sunlight and salt gradients to reduce heat loss through convection, solar ponds can raise water temperatures to near boiling.

Under this project, a circular solar pond has been built on the University of New Mexico campus. Research is now underway to monitor the thermal properties of the pond, to automate data gathering and to devise computer codes for the analysis and interpretation of the data collected. Several heat transfer systems will be analyzed and tested to select the most efficient system. The durability of the materials used and the maintenance requirements for the pond will also be investigated.

PRINCIPAL INVESTIGATOR: Dr. Howard C. Bryant, Department of Physics and Astronomy, University of New Mexico.



Performance Evaluation of the New Mexico State University Solar House

Of the energy consumed in the United States in 1968, 24 per cent went to heat and cool buildings and to provide domestic hot water. Any developments which can reduce this energy consumption will provide the nation with an obvious impact on its energy supplies. The Collins Casa del Sol of the Future, designed to use solar energy for a large percentage of its heating and cooling needs and constructed on the New Mexico State University campus, represents such a development.

This study is investigating the operation of the house. The building is being calibrated for thermal gains and losses, energy consumption of the applicances and solar equipment is being measured and all components of the solar system are being instrumented to determine their individual performances. The efforts of a variety of physical parameters on the overall efficiency of the solar system will be evaluated. The results of this research will then be distributed to contractors and other interested persons throughout the state.

PRINCIPAL INVESTIGATORS: Dr. P. R. Smith and Dr. T. R. Mancini, Department of Mechanical Engineering, New Mexico State University.

Solar Irrigation Pumping Demonstration Project

Approximately half of New Mexico's irrigated agriculture depends upon pumped ground water, which in turn relies largely upon natural gas fuel supplies. With natural gas for irrigation pumping facing possible curtailments as early as 1981 and other hydrocarbon and electrical energy sources inadequate or prohibitively expensive in many areas, farmers are caught in a precarious position.

A solar powered agricultural irrigation pumping system is being developed under this project to help alleviate the situation. A joint project between the State of New Mexico (Energy Resources Board, Interstate Streams Commission and New Mexico State University), the Four Corners Regional Commission and the Energy Research and Development Administration (Sandia Laboratories), the project is establishing a field demonstration pumping unit in the Estancia Valley. Specific objectives of the research are development of a data base on the economics of solar powered irrigation, development and evaluation of modeling techniques for solar irrigation, construction of a first generation demonstration unit, assessment of the needs of the farmer and identification of changes in farming practices which may be required with solar irrigation systems, evaluation of water conservative irrigation techniques such as drip and trickle irrigation and stimulation of interest in the user and supplier sectors.

PRINCIPAL INVESTIGATORS: Dr. George H. Abernathy, Department of Agricultural Engineering, and Dr. Thomas R. Mancini, Department of Mechanical Engineering, New Mexico State University.

An Economical Solar Heated and Cooled Residence for Southern New Mexico

Passive solar systems, which form an integral part of the building structure, offer considerable advantages to homeowners over active systems with their costly collectors and associated equipment. How-

ever, although passive systems have proven very cost effective for heating homes in the northern part of the state, they have not yet been able to provide the cooling needed in the south. Now a type of passive system, called SKYTHERM, has been developed by Mr. Harold Hay of Los Angeles which may be capable of meeting these higher cooling requirements. In the SKYTHERM system, a pool of water is incorporated into the roof design, operating as a heat source during the winter and a sink for energy during the summer. Under this project, a house using the SKYTHERM system is being designed for use in the severe cooling climate of southern New Mexico.

PRINCIPAL INVESTIGATORS: Dr. T. R. Mancini and Dr. P. R. Smith, Department of Mechanical Engineering, New Mexico State University.

Analysis of the New Mexico Solar Resource

Before solar energy can be efficiently utilized in New Mexico, it is necessary to know how much of it is available over the state. The objective of this project is to compile solar insolation data gathered to date.

This goal is being accomplished by surveying existing monitoring programs in the state to determine what information is currently being obtained. Potential users of solar data are being contacted to determine what data is necessary for such applications as heating and cooling of buildings, domestic water heating, agricultural and industrial process heat, solar thermal electrical conversion, photovoltaic conversion and bioconversion. Where the data available could serve a broader need, it will be catalogued and distributed to potential users. At the conclusion of the project, if it seems desirable to coordinate individual solar monitoring efforts in the future, a program will be proposed for this, along with recommendations for possible State involvement in the collection and management of solar data.

PRINCIPAL INVESTIGATOR: Mr. Ray J. Bahm, Bureau of Engineering Research, University of New Mexico.

New Mexico Solar Business Potential

If solar energy is to enhance the economic growth and development of New Mexico, the results of basic research must be applied commercially. This project will help promote such commercialization by providing information on the status of the solar industry in New Mexico and by outlining alternatives open to energy policymakers in attracting solar business to the state.

The first step of the project was to develop an inventory of existing solar energy commercial development in the state. This inventory includes information on industry infrastructure, equipment manufacture and production, the scope of the equipment market and legal and/or market constraints. In the second step, a program is being developed to implement solar energy commercialization. This program will project market forecasts for different industrial groups which might contribute to solar energy commercialization and will consider such problems as necessary legal changes, changes in infrastructure, labor availability and capital and other financial assistance needs.

PRINCIPAL INVESTIGATORS: Dr. Thomas S. Goho and Dr. Bruce W. Kimzey, Department of Finance and Economics, New Mexico State University.

Solar Heated and Cooled State Port of Entry Building

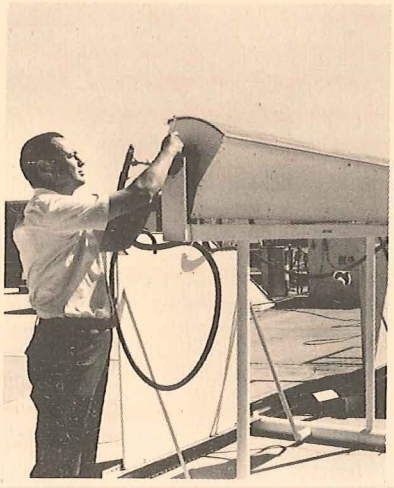
Although the two solar heated and cooled buildings constructed on the New Mexico State University campus have generated considerable interest, a solar building such as a port of entry visitors' center on one of the well-traveled highways of the state would be able to reach the general public in much larger numbers. Under this project, a state-owned site has been selected for the location of such a building. The center and its solar system have been designed and a detailed technical proposal for its construction submitted to the Energy Research and Development Administration, which is soliciting proposals for commercial solar energy space heating and cooling demonstration projects.

PRINCIPAL INVESTIGATOR: Dr. Phillip R. Smith, Department of Mechanical Engineering, New Mexico State University.

Pyranometer Station for Assessment of Solar Energy Influx in Eastern New Mexico

Accurate measurements of insolation, wind and temperature data are necessary if sizes of solar collectors and heat storage units are to be specified properly for any application. Presently, there are very few pryanometer stations collecting precise data on insolation in New Mexico. To increase the data on overall solar flux in the state, a pyranometer station is being established under this project at Eastern New Mexico University in Portales. Recorded data from this station will be transferred to computer cards and made available to all interested parties. In addition, wind observation instruments currently on the site are being upgraded and other meteorological instruments added.

PRINCIPAL INVESTIGATORS: Dr. O. Dayle Sittler and Dr. Mercedes M. Agogino, Department of Physics, Eastern New Mexico University.



Addition of an Air Cooled Collector Test Capability to the Solar Collector Test Facility

The Physical Science Laboratory of New Mexico State University currently operates a facility for testing liquid cooled flat plate solar collectors according to National Bureau of Standards test procedures. However, the number of manufacturers and experimenters using air cooled collectors is increasing and many inquiries have been received as to the testing of this type of collector. An addition to the present test facility is being designed and built under this project to accommodate air cooled solar collectors. The extension to the facility is being limited initially to two test stands capable of testing two collectors simultaneously, with capability for additional enlargement in the future.

PRINCIPAL INVESTIGATOR: Mr. Harold L. Connell, Physical Science Laboratory, New Mexico State University.

Application of Solar Energy to Heating of Greenhouses

The successful application of solar heating to existing commercial

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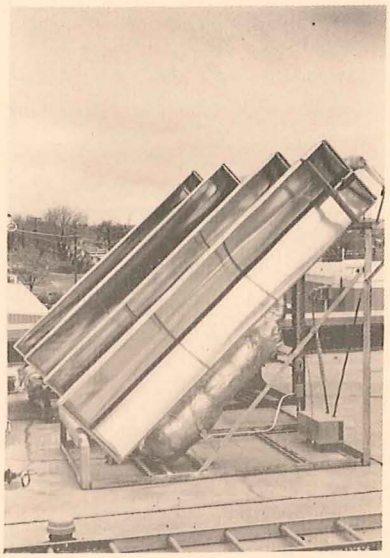

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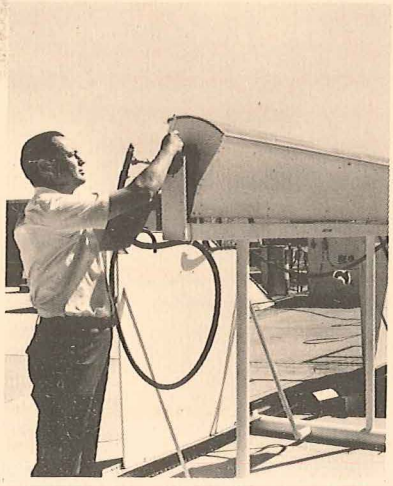

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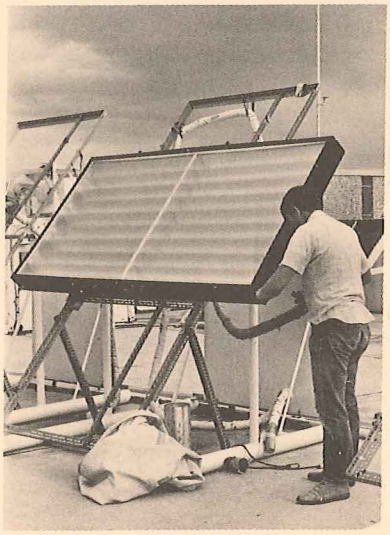
The successful application of solar heating to existing commercial

greenhouses in New Mexico may rescue these businesses from the problems of increasing hydrocarbon fuel costs and decreasing availability. Under this project, several possible solar applications are being studied, including means for rendering present structures more thermally efficient and methods for utilizing excess daytime energy loads for nighttime heating. From this information, one or more complete system designs for heating greenhouses with solar energy will be developed.

PRINCIPAL INVESTIGATOR: Mr. J. D. LaPlante, Department of Mechanical Engineering, New Mexico State University.

Photochemical Solar Energy Conversion

A photochemical reaction capable of converting solar radiation into usable chemical energy has been discovered by the Principal Investigator of this project. The reaction uses the influence of light on copper (I) chloride and hydrochloric acid to form hydrogen gas. It has all the desirable features of a photochemical solar energy conversion system except for relatively poor sensitivity in the spectral zones common to terrestrial solar radiation. This project is investigating means of improving the sensitivity of the reaction to longer wavelengths, which would make the process competitive with other projected photoconversion schemes.



PRINCIPAL INVESTIGATOR: Dr. Dennis D. Davis, Department of Chemistry, New Mexico State University.

Solar Energy Information Service

The goal of the New Mexico Solar Energy Association is to educate the people of the state in potential solar solutions to meet their individual energy requirements. Under this project, specific steps being taken to further that goal include an expansion of the resource center in Santa Fe, creation of a sister office in Las Cruces and formation of a demonstration outreach program. Educational activities include initiation of a solar energy toll-free phone line; maintenance and expansion of reference libraries; response to queries for information on solar energy; publication of a monthly newsletter and quarterly journal; coordination of conferences, workshops, seminars and classes; preparation of "how-to" manuals; distribution of pamphlets, books and manuals; and conducting tours.

PRINCIPAL INVESTIGATOR: Mr. Keith Haggard, New Mexico Solar Energy Association.

Completed Projects

"Transition Metal ION Complexes as Catalysts in Solar Decomposition of Water to Produce Hydrogen," Dr. E. R. Birnbaum, Dr. D. D. Davis, Dr. G. J. Ewing and Dr. J. H. Hageman, Department of Chemistry, New Mexico State University.

"Solar Collector Test Facility," Mr. Harold L. Connell and Mr. William C. Stevens, Physical Science Laboratory, New Mexico State University.

"Instrumentation System for the New Mexico Department of Agriculture Solar Heated and Cooled Building," Dr. Robert L. San Martin, Department of Mechanical Engineering, New Mexico State University.

"New Mexico State University Solar Heated and Cooled Demonstration House," Dr. Robert L. San Martin, Department of Mechanical Engineering, New Mexico State University.

"Completion and Evaluation of the Performance of the New Mexico State University Solar House," Dr. Phillip R. Smith and Dr. Thomas R. Mancini, Department of Mechanical Engineering, New Mexico State University.

"Thermal Trap Solar Energy Collector," Dr. Phillip R. Smith and Dr. Milan Cobble, Department of Mechanical Engineering, New Mexico State University.

WIND ENERGY

Analysis of the New Mexico Wind Energy Resource

As with other alternative energy sources, wind energy is gaining increased attention in New Mexico. However, before this resource can be efficiently harnessed, a means of coordinating future data gathering efforts with those of the past and present needs to be developed.

Under this project, an assessment is being made to determine data requirements for various wind energy applications, including electrical power generation for isolated individual homes, for farm and ranch operations and for both small municipal and large utility electrical systems. A survey is being made of past, present and planned wind velocity observational programs carried out within the state. Following this survey, any data which have the potential for broader application will be catalogued and made more readily accessible. Finally, a program will be proposed to coordinate collection of present and future wind data in New Mexico, including recommendations on possible State involvement in establishing and maintaining a state wind data base.

PRINCIPAL INVESTIGATOR: Dr. Kenneth Barnett, Physical Science Laboratory, New Mexico State University.

Information Dissemination on Wind Energy

Wind power for water pumping is currently seeing a resurgence of interest and is competitive with conventional energy sources. Wind-electric systems, while seldom competitive today where conventional electric power is readily available, do offer attractive sources for many isolated users, such as ranches, farms and cabins. To assist individuals in the practical application of wind power to their needs, the Physical Science Laboratory of New Mexico State University, under this project, is compiling available information in these areas and reducing it to a series of brochures. These brochures will lead a person through the various aspects of determining his wind resources as well as the selection and installation of a complete wind power system.

PRINCIPAL INVESTIGATOR: Dr. Kenneth Barnett, Physical Science Laboratory, New Mexico State University.

Completed Project

"Initiation of Wind Power Technical Center," Dr. Victor J. Skoglund, Department of Mechanical Engineering, University of New Mexico.

GEOTHERMAL ENERGY

Engineering Methods for Predicting Productivity and Longevity of Hot-Dry-Rock Geothermal Energy Reservoir in the Presence of Thermal Cracks

A low temperature heat, man-made geothermal energy reservoir underlying the Jemez Plateau has been drilled by the Los Alamos Scientific Laboratory. By using cooling stresses, new cracks were formed along the surfaces of the initial hydraulic fracture system, propagating far beyond the cooled region. Both the heat transfer surface and the heat energy available to a fluid circulating through the crack system were therefore increased, and continue increasing as energy is withdrawn from the goethermal reservoir.

The objectives of this study are to show how the initial hydraulic fracture zone can be extended through thermal elastic cracking of the adjacent hot-dry-rock, to develop methods for predicting the productivity and longevity of a reservoir and to establish a basis for a future comprehensive experimental and analytical study of hot-dry-rock treated as elastic-plastic material.

PRINCIPAL INVESTIGATOR: Dr. Y. C. Hsu, Department of Mechanical Engineering, University of New Mexico.

Evaluation of Geothermal Potential of the Basin and Range Province of New Mexico

Geothermal anomalies are commonly characterized by recently active volcanism, high heat flow, young hydrothermal mineral deposits, hot springs or wells, seismic activity and extensional tectonics. There are 60 such known anomalies in New Mexico, with varying degrees of energy resource potential.

This interdisciplinary, interinstitutional project is assessing the energy potential of virtually all these known areas, excepting only areas being currently investigated by other researchers or developed by private industry. The assessment is being accomplished through detailed and reconnaissance geologic mapping, compilation of tectonic maps, deep electric-resistivity surveys, electromagnetic soundings, gravity and magnetic measurements, chemical and isotopic studies of fresh and altered rocks and thermal waters, petrologic studies and radiometric dating. The results will provide the basic information needed by land owners and industry for making decisions on investment for geothermal exploration.

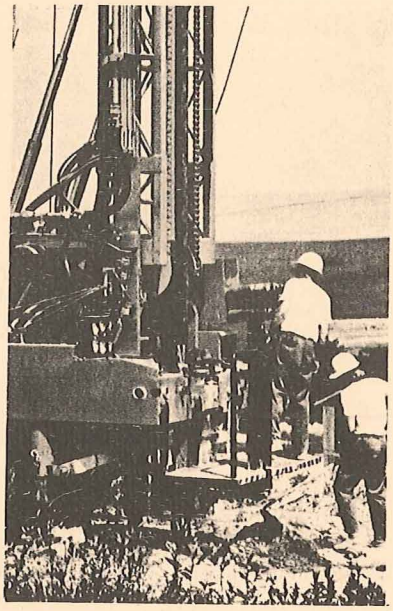
PRINICPAL INVESTIGATORS: Dr. Jonathan F. Callender, Dr. Douglas G. Brookins, Dr. Wolfgang E. Elston, Dr. George R. Jiracek, Dr. Albert M. Kudo, Dr. Gary P. Landis and Dr. Lee A. Woodward, Department of Geology, University of New Mexico, and Dr. Chandler A. Swanberg, Departments of Physics and Earth Sciences, New Mexico State University.

Seismic Exploration for Shallow Magma Bodies in the Vicinity of Socorro, New Mexico

Recent geophysical observations suggest the existence of shallow bodies of molten or partially molten rock beneath the Rio Grande rift near Socorro. Such areas may prove suitable for geothermal energy development. The objective of this project is to confirm the location of these shallow magma bodies through seismic exploration and to help localize the best areas for testing the geothermal potential of the region.

PRINCIPAL INVESTIGATORS: Dr. Allan R. Sanford and Dr. John W. Schlue, Department of Geoscience, New Mexico Institute of Mining and Technology.

Geological Investigation of the Socorro Geothermal Area



The Socorro area has both geological and geophysical characteristics of a major geothermal system. This project is helping to support the detailed geologic mapping needed for delineating the most favorable areas for geothermal exploration as well as providing the stratigraphic framework for estimates of drilling depths and aquifer characteristics. It is also supporting the dating of volcanic rocks necessary for unraveling the complex overprinting of similar rocks of different ages and for establishing the patterns of volcanism in space and time. Chemical analyses conducted under this study are helping to characterize the types of magmas involved in the several eruptive periods.

PRINCIPAL INVESTIGATOR: Dr. Charles E. Chapin, New Mexico Bureau of Mines and Mineral Resources.

Geothermal Application Feasibility Study for the New Mexico State University Campus

A geothermal area adjacent to the New Mexico State University campus has demonstrated water temperatures in the range of approximately 100 to 200°C. As some of these temperatures are above the minimum considered necessary for economic development, the area may potentially provide enough energy to at least partially meet the heating, cooling and electrical power needs of the campus.

The primary objective of this project is to determine whether geothermal development of the area is practical. In order to accomplish this, the investigators are:

1. Identifying the hardware needed for extracting the geothermal energy and converting it to more usable forms;
2. Determining whether existing systems could be used to deliver the energy produced or whether new ones would have to be developed;
3. Investigating the economics of the proposed system and the feasibility of its construction;
4. Developing environmental impact information; and
5. Outlining any regulatory or institutional impediments to the system's construction and operation.

PRINCIPAL INVESTIGATORS: Dr. Narendra N. Gunaji, Department of Civil Engineering, Dr. A. G. Walvekar, Department of Industrial Engineering, Dr. Leo LaFrance, Department of Mechanical Engineering, Dr. E. Thode, Department of Marketing and Management, Dr. L. Chaturvedi, Departments of Earth Sciences and Civil Engineering, and Dr. Chandler Swanberg, Departments of Earth Sciences and Physics, New Mexico State University.

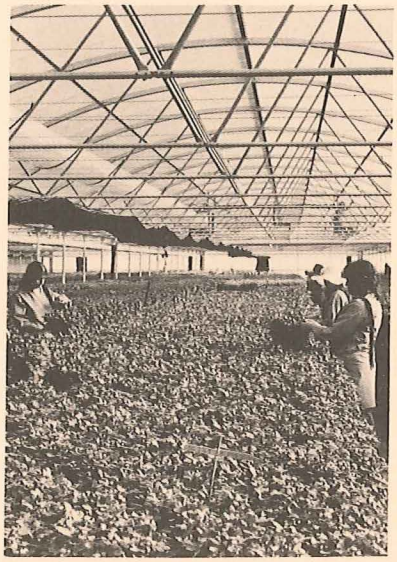
Deep Terrestrial Heat Flow Measurements in New Mexico and Neighboring Geologic Areas

Terrestrial heat flow measurements have important applications both to evaluation of regional geothermal potential and to better understanding of hydrocarbon pool formation. The most significant problem in measuring these geothermal gradients, however, is abstraction of heat by groundwater movement. This project is seeking to accurately measure geothermal gradients in New Mexico and neighboring geologic areas by deep temperature logging of a dozen or more wells of about 5,000 feet and deeper. These wells should be below zones of

groundwater movement and are being made available for use by various industrial organizations.

PRINCIPAL INVESTIGATOR: Dr. Marshall Reiter, New Mexico Bureau of Mines and Mineral Resources and Department of Geophysics, New Mexico Institute of Mining and Technology.

Feasibility Study of Geothermal Energy for Heating Greenhouses



Presently, the majority of commercial greenhouses in New Mexico use either natural gas of propane for heating in winter. This project is studying the technical and economic feasibility of using low temperature geothermal sources to heat these facilities instead. The geothermal heating system is being compared to that of existing gas-fired heating systems in terms of initial capital investment and projected operating and maintenance costs. Geothermal sources suitable for heating applications, either with existing greenhouses or with possible future facilities, are being identified.

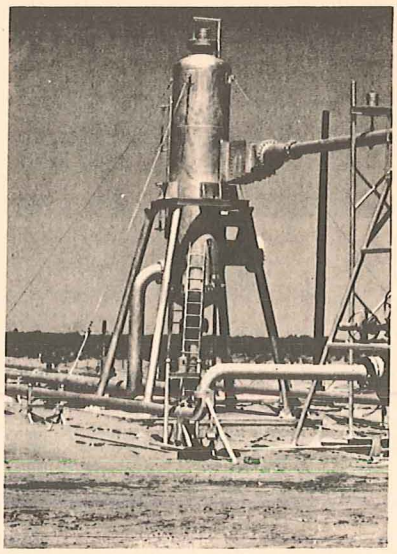
PRINCIPAL INVESTIGATOR: Dr. Leo J. LaFrance, Department of Mechanical Engineering, New Mexico State University.

Geothermal Resources of New Mexico: A Survey of Work to Date

A comprehensive survey of geothermal research and development work accomplished to date in New Mexico is needed before significant further development can take place. Under this project, such a survey is being developed. The location and natural setting of target areas are being summarized, as well as the status of research, exploration, leasing and drilling. The completed report will draw together the various published data relating to the state's potential resource areas, summarize development efforts to date, give the names and locations of persons presently engaged in research on geothermal resources and briefly state their areas of interest.

PRINCIPAL INVESTIGATOR: Dr. William J. Stone, New Mexico Bureau of Mines and Mineral Resources.

Geothermal Application Feasibility Study for the New Mexico Institute of Mining and Technology Campus



A geothermal source located within about two miles of the New Mexico Institute of Mining and Technology on land owned by the Institute is believed to have a thermal gradient approximately seven times that normally found in the area. The purpose of this project is to determine the economic, technical and environmental feasibility of providing the space heating, water heating, cooling and electrical power needs of the Institute by harnessing this energy source. For the purposes of this study, the geothermal source is assumed to have ideal resource characteristics, such as quality, quantity and heat content. The primary question being addressed is whether harnessing and delivering this energy to the campus, and perhaps the community as well, would be economical compared to present energy costs.

PRINCIPAL INVESTIGATOR: Dr. Alan R. Miller, Department of Metallurgy, New Mexico Institute of Mining and Technology.

Use of Geothermal Energy for Desalination in New Mexico - A Feasibility Study

Studies are now being conducted to document the geothermal resources of New Mexico, with some areas demonstrating sufficient potential to warrant consideration for economic development. Another potential economic resource in the state is saline water, which is not currently being used despite the large quantities available and increasing competition for fresh water rights. This project is examining the possibility of using energy from the state's geothermal resources to desalinate otherwise unusable water for industry, agriculture and municipalities. Specifically, the project is identifying the need for and possible uses of desalinated water, investigating the presence of geothermal areas which might be economically used for desalination purposes, gathering information about desalination techniques and how these can be integrated with geothermal energy sources and studying the economics of applying these proposed methods and techniques.

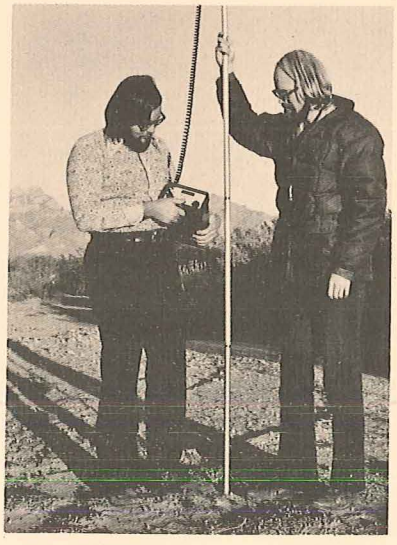
PRINCIPAL INVESTIGATORS: Dr. Lokesh N. Chaturvedi, Departments of Earth Sciences and Civil Engineering, Dr. Conrad Keyes, Jr., Department of Civil Engineering, Dr. Yash Gupta, Department of Chemical Engineering, and Dr. Chandler A. Swanberg, Departments of Physics and Earth Sciences, New Mexico State University.

Completed Projects

"Geothermal Potential of Rio Grande Rift," Dr. Douglas G. Brookins, Dr. Jonathan F. Callender, Dr. George R. Jiracek, Dr. Albert M. Kudo, Dr. Gary P. Landis and Dr. Lee A. Woodward, Department of Geology, University of New Mexico.

"Oxygen Isotope Geochemistry and Geothermal Energy Potential in New Mexico," Dr. Gary P. Landis, Department of Geology, University of New Mexico.

"Geothermal Gradient Measurements," Dr. Marshall Reiter, New Mexico Bureau of Mines and Mineral Resources and Department of Geoscience, New Mexico Institute of Mining and Technology.



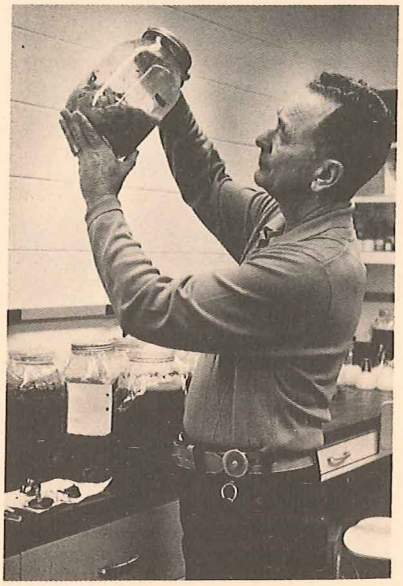
"Investigation of Thermal Regime of Rio Grande Rift and Neighboring Provinces by Employing Very Deep Heat Flow Measurements and Establishing a Crustal Radiant Heat Generation," Dr. Marshall Reiter, New Mexico Bureau of Mines and Mineral Resources and Department of Geoscience, New Mexico Institute of Mining and Technology.

"Seismic Investigation of Magma Layer in Crust Beneath Rio Grande Rift near Socorro, New Mexico, (and Relative to Geothermal Energy Potential of Region)," Dr. Allan R. Sanford, Department of Geoscience, New Mexico Institute of Mining and Technology.

"Geothermal Equipment," Dr. Chandler Swanberg, Departments of Earth Sciences and Physics, New Mexico State University.

"Geothermal Investigations in Southwest New Mexico," Dr. Chandler Swanberg, Departments of Earth Sciences and Physics, New Mexico State University.

ENERGY FROM WASTE CONVERSION



Sewage and Refuse as Energy Sources

Treatment and disposal of organic wastes in sewage and refuse have traditionally placed a burden on society. Now these wastes have assumed the importance of a possible resource, capable of supplying energy and even protein through enzyme conversion. The enzyme-anaerobic process being studied in this project differs from the conventional anaerobic process in converting large amounts of refuse rapidly and maintaining versatility whereby different products could be harvested from the system. This is accomplished by first reducing the components of garbage and sewage to simpler products through enzyme conversion. These components are then used to grow algae, which in turn yield a continuous supply of consistent material for further enzyme conversion to simple sugars. These sugars are finally transformed anaerobically to products such as alcohol and methane.

Microorganisms have been selected for use in the enzyme generators and their capacity to degrade multiple substrates have been determined. Other microbes with greater capacities are being sought. A scaled-up model to further determine reaction efficiencies is being constructed and tested.

PRINCIPAL INVESTIGATORS: Dr. Eugene E. Staffeldt, Department of Biology, Dr. William A. Barkley, Department of Civil Engineering, and Dr. C. Quentin Ford, Department of Mechanical Engineering, New Mexico State University.

Waste Heat and Waste Products Recovery Potential for New Mexico

An inventory of sources and quantities of energy in New Mexico which are not currently being used beneficially is not only timely, but necessary. This project is satisfying that need. In addition to compiling such data, any restrictions in realizing energy recovery from these sources are being evaluated and alternatives for utilizing waste energy sources are being developed.

PRINCIPAL INVESTIGATORS: Dr. E. Groth, Jr., Department of Chemical Engineering, Dr. W. C. Hull and Dr. D. M. Zallen, Department of Mechanical Engineering, New Mexico State University.

OTHER AREAS OF ENERGY RESEARCH

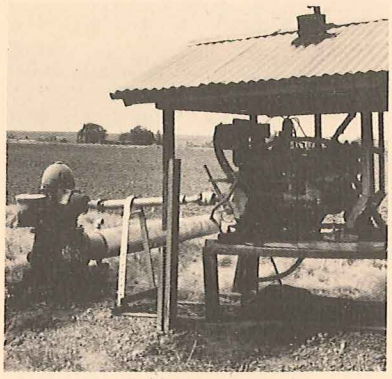
Evaluation of Long Term Effects of Thermal Effluents on Stream Biota

The next two decades are likely to see the development of both coal and nuclear powered electric generating plants in New Mexico. These plants, with their requirements for vast amounts of cooling water, present potential thermal pollution problems for the state's lakes and streams. A "normal water" data base needs to be obtained to evaluate the effects of these effluents.

This study is designed to create such a data base by studying the species composition and relative abundance of chironomid midge larvae, or blood worms, at representative stream sites throughout the state. Chironomids as a group are among the most ubiquitous of the macroinvertebrates in fresh water, while many of the species have restricted habitat preferences. The survey results should therefore enable predictive models to be developed. Cytogenetic studies will also be conducted to aid in evaluating possible genetic effects of long term, low level radioactivity in nuclear cooling waters.

PRINCIPAL INVESTIGATOR: Dr. James E. Sublette, Department of Biology, Eastern New Mexico University.

Improving the Energy Conversion Efficiency of Natural Gas Irrigation Pumping Units



About 30 per cent of the water used for irrigation in New Mexico is pumped using natural gas as a primary fuel. The price of natural gas is expected to rise dramatically in the next few years and the supply is expected to decline to the point of severe competition among users. It is therefore critical to the agricultural economy of the state that these pumps operate as efficiently as possible. However, natural gas driven pumps in Texas, New Mexico and Oklahoma currently show an overall efficiency of only 10.7 per cent.

Under this project, a testing program is being made available to farmers in the state to evaluate the energy conversion efficiency of their pumping units. Where efficiencies are unreasonably low, the reasons are determined by engine and pump tests and recommendations for improving efficiency are made. It is estimated that this program should be able to raise the average efficiency to about 15 per cent. In addition, irrigation pumping seminars are being organized through the New Mexico State University Cooperative Extension Service.

PRINCIPAL INVESTIGATOR: Dr. George H. Abernathy, Department of Agricultural Engineering, New Mexico State University.

Completed Projects

"Development of Policies for Energy Use in Food and Fiber Ecosystem of Southwest with Special References to New Mexico," Dr. Robert R. Lansford, Department of Agricultural Economics, New Mexico State University

"The Design and Construction of a Prototype Sulfur Monitoring System," Dr. Thomas M. Niemczyk, Department of Chemistry, University of New Mexico.

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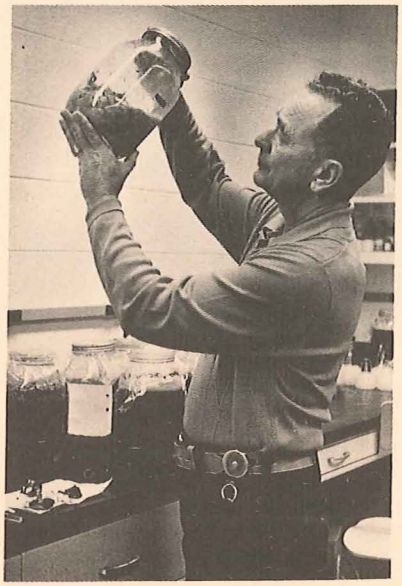

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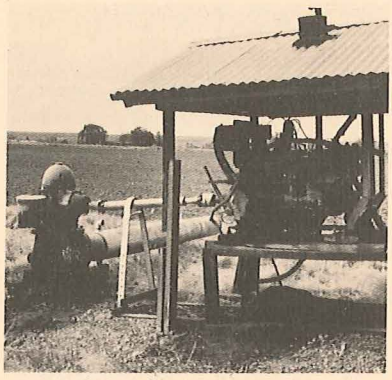

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