

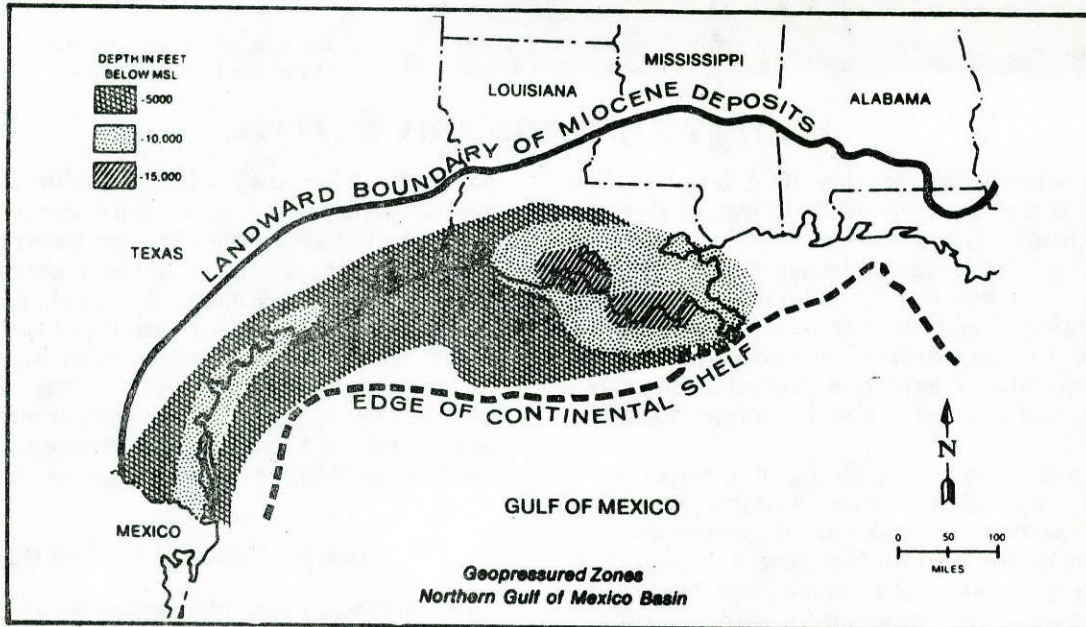
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ENERGY STUDIES

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Geothermal Energy for Texas



Geothermal energy is increasingly being recognized as an important energy source that has the potential to supplement fossil fuels. This energy can be used for electric power generation, low-temperature space heating in homes and industry, absorption air conditioning, and process heat.

Geothermal energy has been tapped since early in this century in various parts of the world, but today the technology exists for much greater use of this resource. Some research, in fact, estimates that geothermal energy will ultimately be able to meet half the electric power generating needs of the United States.

Modest amounts of electricity are already being generated by geothermal steam in the United States, Italy, Japan, Iceland, Mexico, and New Zealand. In Iceland today, entire communities are heated with hot geothermal water.

Basically, geothermal energy is heat from the interior of the earth which can be reached from the earth's surface. It occurs in the form of water, steam, or hot dry rocks. The temperatures of the earth increase with depth, reaching an estimated 6000 to 8000° at its center.

Volcanoes and hot springs are common evidences of the large amounts of heat from the earth's interior which reach the surface. Present technology, however, only allows for the drilling and economical utilization of relatively large geothermal resources at comparatively shallow depths (about 25,000 feet).

The first geothermal field in the United States to be exploited for the production of electricity was at the Geysers field in California. The Geysers is a steam field which began producing in 1960. It now supplies 600 megawatts of electricity yearly or enough to meet the needs of approximately 500,000 people in the San Francisco area.

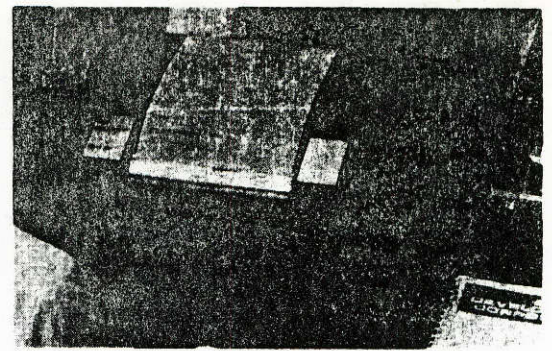
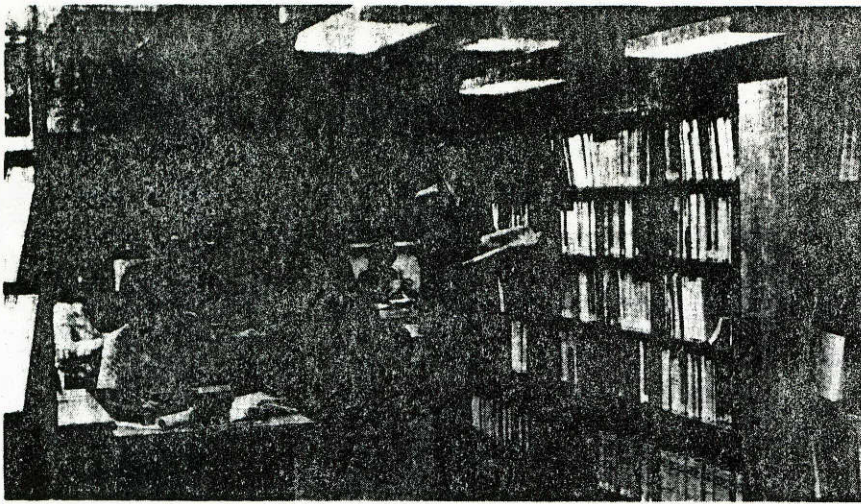
Geopressured Sands

Another major reserve of geothermal energy is found along the Gulf Coast of Texas and Louisiana at depths of from 7,000 to 20,000 feet. In these reservoirs hot water (300 to 400°F) at very high pressure (geopressure) has been trapped in sands by a complex process of sedimentary deposition. There are indications that the water in the geopressured zones might be low enough in salt content to be used for irrigation and consumption with minimal desalination procedures after the heat is extracted. Investigations also show that there may be enough methane gas present in the water to increase the state's natural gas supply significantly.

The Gulf Coast is the only known reserve of geopressured sands in the United States, but other reserves can be found along the continental margins of ocean basins around the world.

The first conference to focus on geopressured geothermal reservoirs was held June 2-4, 1975, at The

Continued on page 5



Above, computer terminal scans an energy data base.

Left, Jerry Matthews, Director of EIS (standing), and patrons use library facilities.

Energy Information Service

The Energy Information Service (EIS) is located in Engineering Science Building 308B. It was established to meet the energy information needs of the university research faculty, the student body, legislators, the business community, and the general public. The service provides extensive literature searches for the faculty, assistance in finding appropriate references for student research, energy-related legislative background for law-making bodies, and answers to general energy questions from the public.

The service maintains a core library of approximately 2000 titles, with over 150 titles added monthly. New titles are listed in a quarterly acquisitions list. Major energy-related periodicals are kept on file, as well as important reference tools on energy. All are encouraged to browse through the magazines, newsletters, federal agency news releases, and other documents in the library. (See list of periodicals received on p. 6.) Registries are maintained on past and present energy research activities at the university. Plans are being made for similar registries which will include energy-related activities statewide.

As a public service, EIS sponsors semimonthly energy briefings during the academic year. Open to the public, the briefings feature guest speakers who give state-of-the-art reports on their area of expertise. The briefings also provide capsule summaries of major national and international energy developments.

To provide thorough retrospective search capabilities, the service has access to major computerized data bases. Highspeed teletype printers enable the service to scan such data bases as the Congressional Information Service for relevant congressional records on any given topic, or the National Technical Information Service, which

makes available over 800,000 technical reports from governmental, private, and university research facilities. Through the Smithsonian Science Information Exchange data base the service can keep abreast of ongoing research projects funded by local, state, or federal governmental agencies. In all, there are more than two dozen comprehensive information banks available to the service covering relevant areas of engineering, geosciences, business management, chemistry, agriculture, education, government research and development, life sciences, medicine, and petroleum.

New Associate Director

Dr. Martin L. Baughman will serve as Associate Director for Energy Modeling at the Center for Energy Studies effective July 1.

While at CES, Dr. Baughman will head the center's effort to develop the tools and techniques for energy policy analysis and energy supply and demand forecasting. He received his Ph.D. from the Massachusetts Institute of Technology in 1972 where he has been directing a major project on energy system modeling.

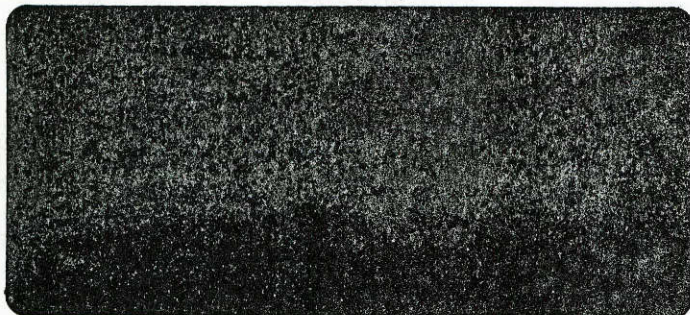
Office of Technology Assessment

The Congressional Office of Technology Assessment (OTA) has contracted with CES to assist the OTA with their analysis of the federal energy research and development program. The first phase of this open-ended contract extends from July 1 to December 31, 1975, and totals \$69,070.

Geothermal Grants

Gulf States Utilities Company has awarded \$75,000 to CES for geothermal energy research in a three-year period to begin July 1975.

This grant is one of three Texas utility grants to CES. In October 1974 Central Power and Light Company of Corpus Christi and the Texas Utilities Services Company of Dallas each committed \$150,000 to the center for geopressured geothermal research.



From the Directors

This issue of *Energy Studies* marks the beginning of a new communications effort on the part of the Center for Energy Studies. In this new quarterly newsletter we will provide information on center activities and will survey the technical, societal, and environmental research going on at this university to alleviate the nation's energy problems.

By way of background, the center was created in 1974 to serve as a central liaison office for the energy research and educational activities at the university and to provide a formal focal point for the collection and dissemination of energy information.

Of course, many energy-related and educational programs were already being actively pursued at the university. It was the center's goal not to replace nor duplicate these active programs but to cooperate with and support them. In addition, the center was enjoined to expand the university's energy program in areas where additional efforts appeared desirable.

In seeking to achieve its goals, CES was organized with three basic principles in mind:

1. Energy programs, in general, should be multidisciplinary in their approach. In too many cases the responses of both the public and its elected leaders to emerging energy problems have been to seek quick, technology-based solutions without consideration for social, environmental, or even economic consequences. Recent experience, however, has shown that it is imperative that all facets of the energy problem be addressed as a totality.

2. Energy programs can be most effectively carried out by the integrated efforts of faculty, students, and full-time staff personnel. Properly utilized, the special qualifications and talents of the faculty and the staff reinforce one another and provide a particularly versatile research and education team. Well-qualified students must also be included in this team to provide the trained

personnel who will be needed to take full advantage of research successes.

3. University programs, must be carefully interfaced with governmental, public, and industrial institutions. Maintenance of close liaison with other public and private agencies will not only encourage proper consideration of the practical aspects of energy problems but should also assist in the rapid dissemination of research results into the society.

The center's most active research program to date has been the interdisciplinary study of the Texas Gulf Coast geopressed geothermal resource featured on p. 1 of this issue of *Energy Studies*. Although the geothermal

program is by far the most ambitious one with which the center has been involved up to this time, a number of other projects have been undertaken. The following represent a sample of the activities undertaken by CES over the last year:

- It is conducting a study for ERDA to determine the most effective funding and administrative strategy for developing fusion power.

- It is supporting studies for producing natural gas from Texas lignite.

- It is sponsoring a solar heating and cooling demonstration project.

- It is conducting a study for the Texas Division of Planning Coordination of methods of decreasing energy consumption in state government buildings.

- It is supporting research in electric power plant instrumentation and control.

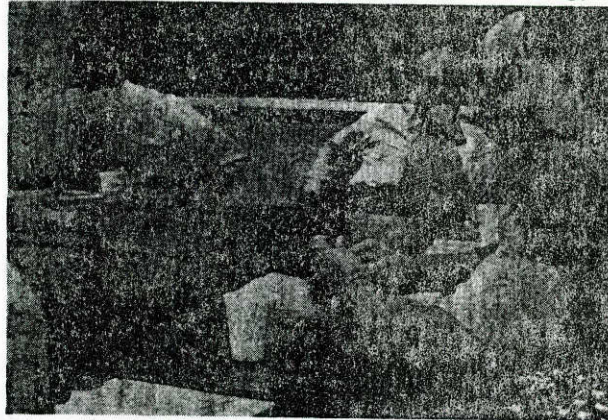
- It is sponsoring a series of radio broadcasts which focus on energy topics and are produced by the Bureau of Business Research and the Longhorn Radio Network.

During the past year we believe that the center has been able to assist in bringing the capabilities of The University of Texas at Austin to bear on the nation's energy problems. We hope that this assistance can increase in the coming years. *Energy Studies* will keep you informed of our progress.

Note

Dr. Woodson is ALCOA Foundation Professor of Electrical Engineering, Chairman of the Department of Electrical Engineering, and Associate Director of the Fusion Research Center.

Dr. Vanston holds an appointment as Assistant Professor, Department of Mechanical Engineering.



John Vanston, Deputy Director (left), and Herbert Woodson, Director (center), at CES June staff meeting.

coming in the fall issue

SOLAR
ENERGY

Solar Gary C. Vliet

Solar energy is available in useful quantities nearly everywhere. However, the technical problems associated with production of electrical and thermal energy from this source have served as major blocks to the economic feasibility of resource utilization.

The solar studies section of CES attempts to find practical solutions to these technological problems by conducting solar heating and cooling demonstration projects. For example, a demonstration system of possibly one or two solar collectors has been initiated on a small four-office complex in Taylor Hall on the UT campus.

Also, a decision is pending on a proposal submitted to ERDA for the retrofitting of Gateway Apartments (university married student housing) for solar heating and cooling. Work has already begun on developing and evaluating an evacuated flat plate solar collector.

Social Systems Research Sally Cook Lopreato

The social systems research section of the Center for Energy Studies examines the social, cultural, psychological, demographic, and economic aspects of energy problems.

Research is carried out on the socio-economic implications of new energy sources. Energy production projects focus on the socio-economic, psychological, and political impacts of power plant siting and policy situations relevant to the electric power industry.

A third major area of research is energy consumption. Concern here is with societal effects of decreased energy consumption and/or higher energy prices. Staff members attempt to answer such questions as, Can an acceptable rate of economic growth be maintained while energy consumption is reduced? and What are the attitudes and motivations of consumers on conservation practices?

Energy Conservation Jerold W. Jones

The recurring shortages of fuel and electrical power have focused public attention on the need to conserve energy. Conservation is the only short-term answer to the energy crisis.

In the energy conservation section of CES, projects are underway to evaluate the energy requirements of typical residential buildings in Austin and in the Texas state capitol complex. Efforts are directed toward identifying those conservation measures which will be most effective in reducing energy consumption.

The first step is to calculate the heating or cooling load of the building. The heating or cooling load is the heat which must be added or removed by the heating or cooling system to maintain the inside temperature at a comfortable level. To determine the load, a computer model is used to simulate the energy flow through the building. The model accounts for internal heat gains, building construction, and actual weather conditions in the Austin area. The efficiency of the heating and cooling system then determines how much energy is required to maintain comfortable inside conditions.

Operations Thomas R. Hill

The center operations division provides functional and liaison support to CES and to other organizations and individuals involved in energy activities. Specific tasks include the cataloging of university energy research projects and available expertise, providing liaison among researchers in related activities, initiating efforts to develop multidisciplinary programs, providing for continuity of existing efforts by recommending allocation of funds and other appropriate center support for new projects. Operations initiates and coordinates quick-response studies and a variety of special projects and is responsible for preparation of proposals and reports.

Dissemination William H. Cunningham

The dissemination lab of CES is carrying on two basic activities this summer. Staff members are initiating a newspaper column which will be distributed within the state of Texas. The column will deal with such topics as future uses of solar and geothermal energy and how to buy and use appliances. Its objective will be to provide the consumer with information that will help him respond to his basic energy problems.

The second project is development of an Energy Agent Program. Two half-time energy agents are now working to establish a basic set of knowledge to permit them to analyze both consumers' and small businesses' energy problems.

Resources and Environment Charles G. Groat

CES has organized this division to assure that resources are fully assessed and environmental concerns are adequately considered in research conducted under the center's auspices. This group has the lead role in the conduct of the geothermal resource assessment project mentioned on p. 1.

In addition, it has organized three studies which, if successful, will enable Texas lignite to be more widely used for the generation of electricity. These studies focus on the suitability of Texas limestones for stack-gas scrubbers and scrubber operation, including sludge disposal.

Continued on page 5

Geothermal Energy for Texas *Continued from page 1*

University of Texas at Austin. Two major areas discussed at the conference were assessment and development of the resource. Assessment means determining which geothermal fields are the most likely to contain hot water and methane that can be utilized readily. Developing the geothermal resource involves bringing it to the surface and actually putting its energy to work.

Some potential problems associated with the Gulf Coast resource are the legal aspects of exploiting geothermal water and the environmental hazards of wastewater disposal and subsidence. The production of electricity from geothermal energy will require the removal of large volumes of water from underground reservoirs. The legal questions focus on ownership of the resource. On the other hand, environmental concerns are related to the unknown salinity of the water and what to do with the water after it has cooled.

In this regard it has been suggested that if the salinity of the water is too high for irrigation or consumption, the water can be reinjected into subsurface oil wells. This reinjection could aid the secondary recovery of oil in these reservoirs and might also mitigate possible subsidence effects.

Current Research

The Center for Energy Studies (CES) at The University of Texas at Austin was granted \$500,000 by the federal Energy Research and Development Administration (ERDA) for a two-year assessment of Texas Gulf Coast geopressured geothermal resources beginning May 1, 1975. Preliminary investigations had been underway for more than a year prior to receipt of the ERDA grant. This study is the first major analysis of a geopressured area in the world and should therefore have global applications.

A primary goal of the research is to determine the best site or sites for the first test well(s). The project is being conducted by the Bureau of Economic Geology at UT-Austin under the direction of Dr. Charles G. Groat, CES Associate Director for Resources and Environment and Acting Director of the Bureau.

Also beginning May 1 was a six-month management and scope-of-work study for development of the Gulf Coast geothermal resource through the first pilot plant. ERDA granted the center \$243,000 for this program, to be managed by Dr. Myron Dorfman, Associate Director for Geothermal Studies at CES and Assistant Professor of Petroleum Engineering.

This feasibility study is attempting to develop the technology required to extract the geopressured energy, to analyze its legal and environmental considerations, and to determine the most appropriate surface technology and power systems to take advantage of the new energy source.

Studies of legal, institutional, and environmental aspects are being directed by Dr. John H. Vanston, Assistant Professor of Mechanical Engineering and Deputy Director of CES. Dr. Charles G. Groat will supervise resource assessment. Reservoir research and technology studies will be conducted by Dr. Augusto L. Podio, Associate Professor of Petroleum Engineering, and Assistant Professor Gary K. Underhill, Mechanical Engineering, will head the surface technology and power systems group.

Program Support

Preliminary geothermal research at UT-Austin was supported by the Atomic Energy Commission and the National Science Foundation and by the university's Bureau of Economic Geology, Department of Petroleum Engineering, and the Center for Energy Studies. In addition, the program has drawn support from the Texas utility industry, including Central Power and Light Company of Corpus Christi, Texas Utilities Services Company of Dallas, and Gulf States Utilities.

Graduate and undergraduate students from several UT academic departments are participating in this large-scale research effort. Also, a two-course interdepartment sequence in geothermal energy resources and utilization was developed in 1974. In these courses students become familiar with the nature of the geothermal resource as well as with the technology necessary to develop and utilize that resource.

With the rapid depletion of our petroleum reserves, alternative sources of energy are required. Geothermal energy represents a viable energy source which may partially fulfill our energy requirements.

For many years Texas had led the nation as a source of energy supply. The University of Texas at Austin has traditionally taken an active role in energy research and the training of youth to work in the energy industry. UT and its Center for Energy Studies are committed to the intensive research and development which will lead to rapid utilization of Texas' geopressured geothermal resource.

Coordination *Clif Drummond*

Continued from page 4

The coordination section of CES has widely diversified responsibilities related to the development of energy policy in all areas of electoral and appointive government. It provides liaison between the center and industrial and educational energy-related activities and it attempts to provide CES with a perspective of the elective political arena.

A primary objective of the Center for Energy Studies is to relate its work directly to societal structures and to the ways in which our nation attempts to resolve energy problems. A fundamental CES principle is that energy problem-solving must be addressed from an integrated set of perspectives—scientific, engineering, societal, and political—if the recommended solutions or alternatives are to be feasible.

Additionally, if the deliberations of policymakers are to be sound and complete, they must be presented not only with realistic energy policy alternatives but also with proper incentives for governmental action.

Through its liaison activities the coordination section assists in achievement of these goals in CES energy studies.

Energy Information Service Periodicals

Access to Energy
 Alternative Sources of Energy
 Bulletin (Geothermal Resources Council)
 Bulletin of the Atomic Scientists
 Chilton's Energy
 Coal Age
 Congressional Quarterly
 Electric Light and Power
 Energy
 Energy Abstracts
 Energy Abstracts for Policy Analysis
 Energy Communications
 Energy Digest
 Energy Info
 Energy International
 Energy Legislative Service
 Energy News
 Energy Perspectives
 Energy Policy
 Energy Today
 Energy Users Report
 Environment
 EPRI News
 Federal Energy News
 Federal Register
 FPC News (Federal Power Commission)
 Geothermal Hot Line
 Government Reports
 Announcements and Index
 Information from ERDA:
 Weekly Announcements
 Information: News & Sources
 INIS Abstracts
 International Gas
 Technology Highlights
 ISES News (International Solar Energy Society)
 Monthly Energy Review
 Monthly Report on Drilling Activity in the United States
 Mother Earth News
 National Journal Reports
 National Science
 Foundation News
 News Report (National Research Council)
 Nuclear News

Oil and Gas Journal
 Quarterly Review of Drilling
 Statistics for the U.S.
 Science
 Science Digest
 Science and
 Government Report
 Science News
 Scientific American
 Solar Energy
 Solar Energy Digest
 Solar Energy Industry Report
 Solar Energy Intelligence
 Report
 Solar Energy Washington
 Letter
 SSIE Science Newsletter (Smithsonian Science Information Exchange)
 Texas Energy
 Texas Energy Report
 Texas Oil Journal
 Texas Water Resources
 TIPRO Reporter
 Todd Nuclear Review
 United States Nuclear
 Regulatory Commission
 News Releases
 Washington Report
 Weekly Energy Report
 Weekly Statistical Bulletin

CES Publications

The following are key publications of the Center for Energy Studies. A complete list of publications and their prices may be obtained by contacting the center.

Policy Alternatives Studies		Price
Study No. 1:	Texas Nuclear Power Policies—Ed. H. H. Woodson and J. H. Vanston, Jr.	\$ 25.00
I	Introduction and Background	4.90
I	Appendices	5.90
II	Methodology	4.90
III	Supporting Industries	4.90
IV	Environmental Effects	3.35
V	Social-Demographic and Economic Effects	6.40
Study No. 2B:	Technology Assessment of Portable Energy RDT & P—J. H. Vanston, Jr., W. P. Frisbie, and D. L. Poston	5.90
Study No. 3:	Alternatives of the Texas Electric Power Industries	Out of print
Supplementary Reports		10.00
1.	"A Study of Electrical Generation and Transmission Plans for Texas (1975-2000)" A. E. Hervey, Jr., H. H. Woodson, and C. D. Zinn	3.90
2.	"The Use of 765Kv as the Major Transmission Voltage in the State of Texas" G. R. Widmeyer, III, H. H. Woodson, and C. D. Zinn	3.90
3.	"An Analysis of an All Nuclear Electric Generation Capability for the State of Texas (1984-2000)" J. A. Pinto, H. H. Woodson, and C. D. Zinn	3.90

Short Course

Energy conservation and solar energy application in residential/commercial buildings were the topics of a course held May 28-31, 1975, in the Joe C. Thompson Conference Center at The University of Texas at Austin. This four-day limited-attendance course, sponsored in part by the center, provided participants with information about:

- methods of evaluating building energy demand
- techniques of energy conservation and evaluating energy savings
- methods of computing energy conservation economics
- descriptions of solar heating and cooling components and systems
- methods of selecting solar system and component size
- state-of-the-art information on solar energy economics

Drs. Gary C. Vliet, Associate Professor of Mechanical Engineering and Acting Associate Director for Solar Studies, CES, and Jerold W. Jones, Assistant Professor of Architectural Engineering and Acting Associate Director for End-Use Conservation, CES, were in charge of the program. The course was conducted by the Departments of Architectural and Mechanical Engineering and administered by Continuing Engineering Studies in cooperation with the Division of Extension.

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