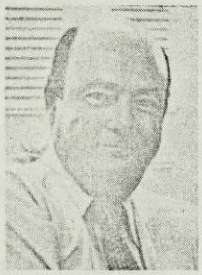
ENERGY STUDIES

ENERGY FOR THE FUTURE: THE CES APPROACH

Though elements of the US public have expressed doubts that this country will be able to meet its energy commitments in another 25 years, the Director of the Center for Energy Studies says this is not our major concern in 1976. According to Dr. Herbert H. Woodson, who is also Chairman of the Department of Electrical Engineering at The University of Texas at Austin, America will not have any trouble supplying needed energy through the year 2000 *if* we can first make it to 1985.



As Woodson sees the situation, our problem from now until 1985 is *"to decide as a society how much we are willing to pay for our energy and our environment."* In essence, this means that the nation will need to decide between extremes of *"a pristine environment without an adequate energy supply and a boundless energy supply without any regard for the environment."* The CES director believes that, logically, the outcome will balance between the two extremes.

Our immediate problem during the next nine or ten years, Woodson says, will be an institutional one. *"We need a decision from society on how much environmental degradation it is willing to accept in order to get what desired level of energy."* The director's hope for the period following 1985 is that the country will have made this decision, or *"gotten off dead center,"* so to speak, and then essentially begun the process of *"dilligently and energetically building what we need to get to the year 2000."*

When Woodson talks about the approach CES takes in tackling energy problems of the future, he says the Center *"would like to put the university in the position of participating in a fully competent, professional way in the solution of the energy problems in Texas and in the nation."* Research conducted at the Center has a unique type of relevancy because of UT's vantage point as a state university located in the state's capital, and because of its reputation as one of the outstanding research universities in the nation. CES research is especially relevant, according to Woodson, because it involves *"a proper mixture"* of researchers, educators and students from the scientific and engineering, as well as the humanistic, sectors of academia. The resulting combination, he says, is able to focus a productive amount of time and effort on the problems the Center is trying to solve. Moreover, CES thus carries out the overall university mandate to provide research, education, and public service in the energy field.

Woodson is confident that the country has the technology it needs to reach the year 2000. *"I don't think there are very many technological inventions that will have any sizable impact on the energy supply from now until then,"* he says. *"We don't need any technological innovations for near-term solutions. We need institutional innovations and we need institutional answers."* The Center's director postulates that *"the Federal Energy Administration, whose role it is to deal with energy policy, probably should spend more on resolving the questions needed to effect near-term solutions."* Overall, however, he feels that both the federal and local governmental roles *"should be definitely limited."* Further, *"a business climate should be established in which private industry can do what needs to be done to actually put in place the energy supplies we need."*

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CES

WHAT IS THE ROLE OF ANALYTICAL PLANNING MODELS IN THE FORMULATION OF ENERGY POLICY?

Martin L. Baughman, *Coordinator of Systems Analysis*

Energy policy alternatives are proposed, assessed, formulated and implemented at two fundamental and interrelated levels. First, the *policymaker* must identify the many dimensions of the overall strategic goals. At the federal level, the decision to lessen our reliance upon foreign energy resources is such a policy initiative. Secondly, it becomes the responsibility of the *planner* to synthesize and analyze the alternatives for reaching the specified goal. To achieve a goal of energy independence, a planner will weigh the various research and development strategies, pricing policies, fiscal and tax measures, and conservation incentives aimed at reducing import requirements.

The function of a model in the policy-planning process is essentially limited by the inherent distinction between the role of the planner and that of the policymaker. In a strict sense, it is the concern of the planner to synthesize alternative courses of action and evaluate their consequences in terms of their efficacy and trade-offs in bringing about the accomplishment of the policy goal. At the same time, of course, the planner must prescribe how the various trade-off patterns are achievable in terms of specific policy instruments. After this, it becomes the role of the policymaker to select the trade-off pattern which is judged most favorable and which will ultimately be implemented.

Policy Analysis—An Example

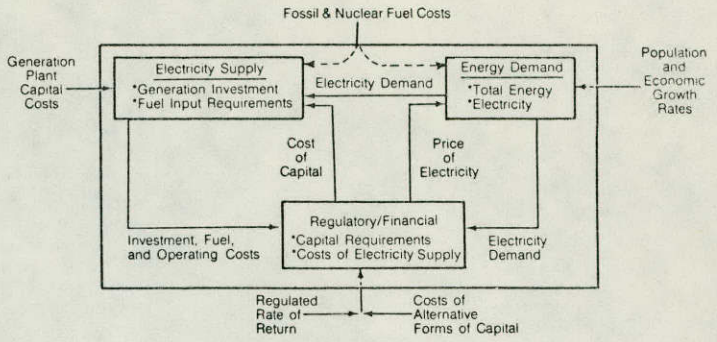
An experiment, or simulation, of an energy model consists of calculating the desired model outputs for a given set of exogenous inputs and rules for computation. The *Regionalized Electricity Model* (see figure) is based on a combination of optimization, engineering, accounting, and econometric concepts integrated into a single interconnected framework. These concepts provide the rules of computation of various model variables, just as the rules of arithmetic provide the computational basis for much of mathematics. The model is a descriptive model, i.e., a mathematical analog of real world behavior, and consists of three parts:

(1) A *regional supply submodel* utilizes the cost-minimizing concepts common to the operation and expansion of an electricity supply system to simulate investment decisions. It contains a set of accounting relationships to recursively update the movement of each type of generation plant through commitment, construction, operation, and scrapping stages of its lifetime. It also simulates the utilization of generation capacity to obtain the fuel requirements for the electricity supply sector.

(2) A *set of energy-demand equations* serves two purposes: *(a)* it interrelates total energy needs in the various sectors of the economy to certain economic, demographic, and climatological parameters; and *(b)* as electricity and other energy prices change, it simulates the changes in consumer fuel choices. The quantitative basis for this part of the model is a set of statistically derived price sensitivity parameters.

(3) A *regulatory-financial submodel* utilizes rate-making rules applicable to the industry to determine the price of electricity. Based upon a flow-of-funds analysis, it also simulates the financing of supply expansion within the normal guidelines of prudent financial management. Since the electric industry is a regulated industry, electricity price levels are established within a set of guidelines which have been adjudicated, generally by state public utility commissions. By modeling this regulatory process, we can simulate future electricity price changes and resulting consumer responses.

A complete mathematical analog of the electricity supply-and-demand system is obtained from the interconnection of the model's three parts. Further, due to the rigors of mathematical formalism, a systematic framework is established wherein experiments are repeatable. That is, the same set of input numbers (e.g., fuel costs, population growth rates, regulated rate of return) yields the same set of outputs (price of electricity, electricity demand, capital requirements, fuel requirements). It is this feature that makes the use of energy models attractive in energy planning.



CONCEPTUAL SCHEMATIC OF THE REGIONALIZED ELECTRICITY MODEL

Application

From the policy analysis perspective, experiments can be performed with changes in the policy instruments. A policy instrument is a variable over which a regulator or decision-maker has control, directly or indirectly. In the electricity example, some of these policy instruments include the length of siting and licensing delays, investment tax credit rates, the rate of return allowed on equity capital, or the air emission standards placed upon utility users of fossil fuels. Analysis of the behavior of the industry under alternative assumptions for these policy instruments is a topic of continuing study in the Center for Energy Studies.

One of the conclusions drawn from analyses done with the *Regionalized Electricity Model* is that, if interest rates and rates of inflation remain high and current regulatory procedures continue, the nation's electric utilities will be presented with substantial capital shortages over the next 20 years. Cash earnings under status quo policies will simply be insufficient to allow the electric utility industry to obtain the capital it needs. The reason is that existing regulatory institutions have not allowed the earned rates of return in the industry in general (there are exceptions) to rise sufficiently to cover the cost of capital.

An important step in utilizing any model is to seek alternative ways to solve the problem. In the case of the *Regionalized Electricity Model,* the results of several experiments show that the most direct means of alleviating the capital problem is to increase the allowed rate of return on equity, which means raising electricity prices to levels above those now being allowed. It appears that prices would have to be between 12 and 15 percent higher on the average than is now allowed under status quo regulation to eliminate the capital shortage problem. Another alternative is to include at least a portion of the construction work in progress in the rate base. Other measures, such as increasing the investment tax credit or further liberalizing depreciation procedures, are found to help, but not to solve, the problem.

As demonstrated, an energy model which has been constructed with relevant variables and tested for its viability can serve as an extremely useful tool for the energy policymaker.

C E S update

AN OVERVIEW of SELECTED MAJOR PROGRAM AREAS

COAL/LIGNITE

The Bureau of Economic Geology (BEG) and CES are finalizing plans for a national lignite conference, to be held June 2-4, 1976. "Gulf Coast Lignite: Geology, Utilization, Environmental Aspects" will be the first public forum for documenting the intensified interest and research activity generated by this vital resource. . . .The largest-funded project in lignite, an *in situ* (in its original place) gasification of lignite study, has been extended for another two years by the National Science Foundation. The study is attempting to develop geological and engineering design bases for the possible application of *in situ* gasification to Texas Deep Basin lignites.

CONSERVATION

Dr. Jerold Jones, CES coordinator for conservation studies, is one of the chief organizers of a one-day symposium on energy conservation and new building design, to be held January 14 on The University of Texas campus. The point of discussion will be "ASHRAE Standard 90-75," a guideline for building design to promote conservation, as developed by the American Society of Heating, Refrigerating, and Air Conditioning Engineering. The standard has been considered as a model for state building codes in over three-fourths of the country. . . .Dr. Jones presented the ASHRAE standard to a group of military, civilians and industrialists at an Energy/Environment Conference in Dallas last month, in preparation for the January ASHRAE conference.

DISSEMINATION

"The Energy Forum," a weekly newspaper column researched and written by CES staff, is now being produced on a regular basis for Texas daily newspapers. The column has the dual purpose of reporting new developments in all energy fields, and of providing the public with specific information on conserving energy in homes and automobiles. . . .Computer coding is in progress for the 2500 responses received thus far to a local gas company's questionnaire on energy conservation attitudes and behavior. The Dissemination section is working with the Social Systems research staff on this project.

ENVIRONMENTAL

Dr. Hal B. Cooper, environmental studies coordinator for CES, has concluded that air pollution control for sulfur oxides can increase the energy consumption rates of copper smelters by approximately 10 percent. Dr. Cooper made the statement in a paper on energy and economic requirements for copper smelter air pollution control systems at the recent Air Pollution Control Association annual conference in Canada.

GEOTHERMAL

The Second Geopressured Geothermal Energy Conference will be held at The University of Texas February 23-25. The conference will focus on the results of the management study for the US Gulf Coast Geopressured Geothermal Feasibility Analysis. Dr. Myron Dorfman, Director for Geothermal Studies at CES, will be the chairman of the conference which will include discussion of resource assessment; reservoir technology; surface technology and resource utilization; and legal, institutional and environmental considerations.

NUCLEAR

Current nuclear engineering projects are focusing on nuclear power public information, which involves numerous presentations to state legislators, members of congress, union officials, media representatives and others on nuclear reactor safety, economics, and radioactive waste management. . . .Dr. E. Linn Draper, coordinator of CES nuclear studies, recently served as "resident expert" in a nuclear power plant tour for a group of editors from 20 women's magazines with a combined readership of over 26 million.

OIL/GAS

Dr. Claude Hocott, coordinator of oil and gas research for CES, has been appointed to the Supply-Technical Advisory Task Force of the National Gas Survey. The Survey was authorized by the US Congress to update a comprehensive analysis of the country's future energy situation, with an emphasis on natural gas. . . .Dr. Robert Schecter, Chairman of the University's Petroleum Engineering Department, presented UT's work on enhanced oil recovery processes using low tension displacing agents to the annual winter meeting of the Interstate Oil Compact Commission. The Commission was authorized by the governors of major oil producing states to deal with long-term conservation measures for the nation's oil and gas resources.

SOCIAL SYSTEMS

A random sampling of apartment tenants in the Rebekah Baines Johnson Retirement Center was begun in November to tap the elderly residents' attitudes towards energy use in the complex, possible future energy savings, and the energy crisis in general. The Retirement Center's Resident Council is working with CES staff to discover ways for improving energy efficiency in the buildings, and will implement viable suggestions in the operation of the complex.

SOLAR

Dr. Gary Vliet, coordinator of CES solar studies, has submitted a proposal to the conservation section of the Energy Research and Development Administration for development of a more efficient absorption air conditioning system with a combined solar/gas energy input. Vliet believes a more efficient absorption system which doesn't take as much solar collector area will be essential for wide-scale use of solar energy. . . .Another federal proposal involves a detailed engineering design to retrofit a 10 family unit of University of Texas married student housing for solar heating and cooling.

CES AIDS CONGRESS STUDY

The Center for Energy Studies recently provided major assistance to the US Congress Office of Technology Assessment (OTA) in conducting a comprehensive study of this nation's energy research and development plans. The bulk of the OTA analysis was done under contract by CES and similar groups at the Massachusetts Institute of Technology and the University of Oklahoma. CES Director Herbert H. Woodson and Deputy Director John H. Vanston served as consultants to an overall review panel for the OTA analysis. In addition, 12 UT energy specialists served on four basic analysis panels, while another six teams of researchers wrote special reports.

The recently released OTA critique centers upon the Energy Research and Development Administration's (ERDA) comprehensive R&D Plan of June, 1975. OTA takes ERDA to task for failing to give sufficient impetus to energy conservation, for neglecting the importance of the steps needed to insure the commercial viability of new energy supply technologies, and for downplaying the role of state and local governments.

STATE CAN SAVE ENERGY

A CES research team led by Dr. Jerold Jones, coordinator of conservation studies, has completed the first phase of a major conservation study of the Texas Capitol Complex buildings. The aim of the study, commissioned by the State Board of Control and the Federal Energy Administration, is to identify those areas where conservation efforts can both save valuable energy and control spiraling costs.

As the first phase of the project, CES researchers analyzed the energy use in the Stephen F. Austin Building, the newest in the complex, to determine ways to conserve energy in all the buildings. Phase I concluded that energy consumption savings of up to 25 percent could be realized at an energy cost reduction of at least $3,000 per month, (1) by significantly reducing lighting plus turning off unneeded office equipment, (2) by reducing the temperature of hot water in the building, and (3) by rescheduling janitorial tasks.

Further details of the study, co-authored by Jones, John Adams and Ted Carnes, are available in CES Publication PR-2, "Minimizing Utility Costs for the State of Texas Capitol Complex Buildings, Phase I."

SPRING ENERGY BRIEFINGS SCHEDULE CONFIRMED

CES will continue to sponsor biweekly Energy Briefings during the Spring Semester, 1976. The briefings, which are intended to provide the latest information on energy research and legislation, will be held in UT's Cockrell Hall Room 1.202, at 4 p.m. on the first and third Wednesdays of the month. The list of speakers for the Spring series and their subject areas are:

January 21	Dr. Claude R. Hocott, *Visiting Professor of Petroleum Engineering, and Coordinator of CES oil/gas studies.* **Enhanced oil recovery.**
February 4	Dr. B. H. Amstead, *Professor of Mechanical Engineering, and Assistant to the Director of CES.* **Solar Series I: Direct application of solar engineering to steam production.**
February 18	Dr. Gary C. Vliet, *Associate Professor of Mechanical Engineering, and Coordinator of CES solar studies.* **Solar Series II: Solar heating and cooling.**
March 3	Dr. Joel W. Barlow, *Assistant Professor of Chemical Engineering.* **Solar Series III: Concentrating collectors.**
April 7	Dr. E. Linn Draper, *Director, Nuclear Reactor Teaching Laboratory, and Coordinator of CES nuclear studies.* **Nuclear fission.**
April 21	Dr. William E. Drummond, *Director, Fusion Research Center, and Professor of Physics.* **Fusion Power.**
May 5	Dr. Stephen L. McDonald, *Professor and Chairman, Department of Economics.* **Federal leasing policy for mineral production.**

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