MASTER

Urban Energy Management: A Course on the Administration of Public Energy Programs

An Instructor's Guide

ENERGY TASK FORCE
of the
URBAN CONSORTIUM FOR
TECHNOLOGY INITIATIVES

Conducted by

Office of Conservation
Seattle City Light
Seattle, Washington

Institute of Public Service
Seattle University
Seattle, Washington

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U.S. Department
of Energy
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The Urban Consortium for Technology Initiatives was formed to pursue technological solutions to pressing urban problems. The Urban Consortium is a coalition of 37 major urban governments, 28 cities and 9 counties, with populations over 500,000. These 37 governments represent over 20 percent of the nation's population and have a combined purchasing power of over $25 billion.

Formed in 1974, the Urban Consortium represents a unified local government market for new technologies. The Consortium is organized to encourage public and private investment to develop new products or systems which will improve delivery of local public services and provide cost-effective solutions to urban problems. The Consortium also serves as a clearinghouse in the coordination and application of existing technology and information.

To achieve its goal, the Urban Consortium identifies the common needs of its members, establishes priorities, stimulates investment from Federal, private and other sources and then provides on-site technical assistance to assure that solutions will be applied. The work of the Consortium is focused through nine task forces: Community and Economic Development; Criminal Justice; Energy; Environmental Services; Fire Safety and Disaster Preparedness; Human Services; Management, Finance, and Personnel; Public Works and Public Utilities; and Transportation.

Public Technology, Inc. is the applied science and technology organization of the National League of Cities and the International City Management Association. It is a nonprofit, tax-exempt, public interest organization established in December 1971 by local governments and their public interest groups. Its purpose is to help local governments improve services and cut costs through practical use of applied science and technology. PTI sponsors the nation's largest local government cooperative research, development, and technology transfer program.

PTI's Board of Directors consists of the executive directors of the International City Management Association and the National League of Cities, plus city managers and elected officials from across the United States.

December 1980

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The research and studies forming the basis of this report were made possible by a grant from the Office of Intergovernmental Affairs of the U.S. Department of Energy (DOE) in cooperation with the Community Energy Program of the Office of Buildings and Community Systems (DOE) through the Energy Task Force of the Urban Consortium for Technology Initiatives.

Grant No. DE-FG02-78IR05106

PREFACE

The Urban Consortium conducts its work program under the guidance of Task Forces which are analagous to the functions of local government. The Energy Task Force is composed of senior level local government energy management practitioners from seventeen of the nation's largest jurisdictions. Beginning in October, 1978, the Energy Task Force initiated a program for practical urban energy management research and development through a series of lead jurisdiction projects funded by a grant from the U.S. Department of Energy. The nature of these projects was determined by the Task Force during its priority setting process.

A description of each of the lead jurisdiction projects conducted under this grant follows:

- Baltimore - Evaluation of Landfill Gas as an Energy Source. This project was designed to develop a process for evaluating the feasibility of methane recovery from sanitary landfills. The evaluation process includes procedures to estimate the methane production life expectancy, the potential quality and quantity of gas produced, types of treatment required and potential methane uses.

- Chicago - A Methodology for Energy Impact Analysis of Community Development Projects. The objective of this project was to develop a method to evaluate the impact large urban development projects can have on an urban jurisdiction's energy supplies and consumption by source. The model developed can analyze options to minimize the energy impact of any new major development.

- Dade County - Primary Urban Energy Planning Methodology Handbook. This project developed an energy planning method that can be implemented incrementally with in-house staff and limited data. The methodology provides guidance for initial organization, data development, formulation of goals, objectives and actions, implementation and monitoring.

- Los Angeles - <u>A Decision Process for the Retrofit of Municipal Buildings with Solar Energy Systems</u>. This project developed a method to aid in identifying, analyzing and selecting solar energy retrofit alternatives for public buildings. The method is designed to assist local government managers in evaluating solar retrofit technologies and their cost effectiveness.

- Seattle - <u>A Course on the Administration of Public Energy Programs</u>. This project developed, evaluated and tested a graduate level curriculum for instruction of local government officials in the management of public energy programs. The course covers national energy issues and policies, government mechanisms for achieving energy conservation, methods for facilitating community involvement and the structure and function of energy utilities.

Public Technology, Inc. serves as the secretariat to the Energy Task Force and provided technical and editorial assistance for the conduct and documentation of these projects.

Management Reports or Technical Guides summarize results of each of the five projects to share experiences with other urban jurisdictions. The Chicago, Dade County and Baltimore methodologies will be applied and expanded by other Urban Consortium jurisdictions in the 1980-81 Energy Task Force work program.

ACKNOWLEDGEMENT

Urban Energy Management -- A Course on the Administration of Public Energy Programs was prepared by the Institute of Public Service, Seattle University, under contract to the Office of Conservation, Seattle City Light. The team which developed the course consisted of Dr. Len Mandelbaum, Institute of Public Service, Seattle University; Dr. Marvin Olsen, Battelle Human Affairs Research Center /University of Washington; and Dr. Barry Hyman, Social Management of Technology Program, University of Washington. Ms. Mimi Sheridan (Program Coordinator) and Ms. Judy Dahlberg (Project Director), both of the Office of Conservation, Seattle City Light, were responsible for overall coordination and direction of the project. Mr. Jeremy O'Brien, Project Engineer, Public Technology, Inc., coordinated comments from members of the Energy Task Force of the Urban Consortium during conduct of the project.

The Seattle Project Team was especially suited for this project because of their composite expertise in public law and policy, sociology and engineering, and because each member of the Team has had a personal interest and involvement in the development and implementation of energy policy in the Seattle area. To assure that the course content and outline would meet the needs of potential instructors and students, the Project Team presented the course at the Institute of Public Service, Seattle University, during the Fall Quarter of 1979. The class consisted of both graduate students and staff persons from the local governments in the Seattle area who generally felt they had benefited significantly from the course. Additionally, the course has been successfully taught in New Orleans, Louisiana, by Dr. Tony Laska, Chairman of the Mayor's Energy Management Task Force, and in Metropolitan Dade County, Florida, by Danny Alvarez, Energy Coordinator, Dade County Office of Energy Management.

Thanks are due to all the above mentioned participants and to those many others who assisted in providing the content and editorial contributions necessary to the development of this document.

Mimi Sheridan
Office of Conservation
Seattle City Light
Seattle, Washington
October, 1980

URBAN ENERGY MANAGEMENT

A COURSE ON THE ADMINISTRATION
OF PUBLIC ENERGY PROGRAMS

NOTEBOOK ORGANIZATION

I. Introduction and Purpose

- o Provides a brief description of the contents, purpose and audience for the course
- o Presented on pages 1 and 2

II. Instructor's Guide

- o Contains an overall course outline and Instructor Outlines for each course session. Includes recommended texts, lecture outlines and suggested readings for each session. Student handouts for each session are contained in Section III of this Notebook.
- o Presented in Tabs 1 through 10

III. Student Outlines and Handouts

- o Contains an overall course outline and student outlines for each session. Includes readings for each session and student handouts as listed in Section II of this Notebook
- o Presented in Tabs 11 through 20

URBAN ENERGY MANAGEMENT

A COURSE ON THE ADMINISTRATION
OF PUBLIC ENERGY PROGRAMS

TABLE OF CONTENTS

I. INTRODUCTION AND PURPOSE

The purpose of this Instructor's Guide is to provide a basic package of training materials organized and structured to guide the conduct of an introductory graduate level course in Local Government Energy Management. The intended audience for the course includes local government administrators and staff as well as graduate students in Public Administration, Urban Studies and Planning. The course content emphasizes policy and administrative issues surrounding the development and implementation of Local Government Energy Management Programs rather than the technical details of energy audits or structural and mechanical energy conservation techniques. The primary objective of the course is to provide local government administrators, staff and students with the background knowledge to deal effectively with a broad range of energy management concerns and is not to train technical energy conservation specialists.

This Notebook is a guide designed for use by an instructor or a team of instructors knowledgeable in the field of energy management and local government administration. Although the majority of the course is usable and applicable in any local government environment, it should be recognized that portions of the course, especially with regard to citizen involvement and methods of planning for energy management, present Seattle viewpoints. With this in mind, instructors considering use of the Guide should view it as a resource which must be adapted to fit local needs and institutional structures.

The course outlined in this Guide is planned for one academic quarter consisting of ten to eleven class sessions of about two and one-half hours each. A class project is described and it is of considerable importance to integrate the lessons learned in the course lectures and readings. The Notebook includes outlines for the instructor(s) and outlines for students. Where allowed by copyright law, student handouts are included. Primary text references and suggested reading assignments for each class session are noted on the instructor and student outlines.

It is emphasized that this notebook is meant to be a flexible Guide to assist training needs for Local Government Energy Management. The objective of flexibility requires that instructors review the contained materials to make modifications, additions, or deletions as required by changes in federal policy or specific state and local government needs and emphases.

Some of the subjects covered in the Guide may be expanded, depending on local circumstances or interest. One example might be to include more details on the various methods of encouraging utilization of renewable energy resources. Other subjects may be deemphasized. Several areas, noted in the outlines, require adjustment for the local situation: the descriptions of your state energy office and its programs, local energy programs and processes, and energy pricing and forecasting. Making use of available guest lecturers would be a very good way to cover some topics and to add variety to class presentations. For instance, a utility representative or a local official involved in energy issues could be very informative, and could provide the basis for very useful discussions.

Several sections in the Guide will require regular updating: the charts and tables, national and state legislation, funding sources, and supplementary readings. The instructor must remain aware of major developments in the field and in the literature, and keep the information current.

It is important to note that the energy management techniques described in the Guide are primarily external in focus (i.e., aimed at influencing the actions of citizens outside the local government). Historically, Seattle has been deeply involved with citizen participation. However, cities that do not now wish to get involved in such efforts can utilize similar techniques internally. Examples of this would be employee awareness programs, mandatory departmental allocations or energy budget cutbacks.

Other alterations may be necessary to fit your local conditions. This Guide does, however, present a logical framework within which to develop a locally "tuned" course on Energy Management. As such, it represents an important step in the development of a new field of Public Administration. Energy Management as a defined responsibility of local government will develop gradually over a period of years. This Guide, with your modifications, is an essential part of the maturation process.

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URBAN ENERGY MANAGEMENT COURSE
OUTLINE FOR THE QUARTER

Session	Topic
1.	Introduction A. Overview of the course B. Basic energy concepts
2.	The Energy Problem A. History of energy use B. U.S. energy trends during 1970-1973 C. Current energy sources
3.	National Energy Policies and Programs A. Alternative energy policy perspectives B. Federal energy legislation since 1974 C. Current federal energy policy proposals
4.	State and Local Energy Programs A. Funding sources for state and local programs B. State energy programs C. Local energy programs D. Citizen participation in energy management
5.	Techniques of Energy Planning A. Energy demand forecasting B. Energy economics and pricing
6.	Techniques of Energy Conservation A. Principles of energy conservation B. Energy conservation in buildings C. Energy conservation in transportation D. Energy conservation in industry
7.	Techniques of Renewable Energy Production A. Principles of renewable energy production B. Substitute fuels C. Solar Heating D. Electricity generation
8.	Strategies for Voluntary Energy Management A. Introduction to implementation strategies B. Principles of the voluntary approach C. Information techniques D. Mobilization techniques
9.	Strategies for Financial Energy Management A. Principles of the financial approach B. Pricing techniques C. Incentive techniques
10.	Strategies for Mandatory Energy Management A. Principles of the mandatory approach B. Regulatory techniques C. Design techniques

SESSION 1. INTRODUCTION

Instructor Outline

A. Overview of the Course

1. Purpose of the course

   a. Overall goal:

      This graduate-level course is intended for local (city and county) public officials and graduate students in public administration who desire or expect to work in the area of urban energy management. It does not assume that they have any previous knowledge or experience in energy management, but it does assume that they are committed to reducing the consumption of energy from nonrenewable sources. The goal of the course is to give them a foundation of knowledge about urban energy management that will enable them to begin undertaking these responsibilities in their job.

   b. Specific objectives: To familiarize students with:

      (1) The nature of the energy problem and current federal, state, and local efforts to deal with it.

      (2) Basic techniques of energy planning, energy conservation, and renewable energy resources.

      (3) Strategies for energy management using voluntary, financial, and mandatory approaches.

2. Structure of the course

   a. Course outline and session topics: See Attachment 1-A

   b. Reading assignments:

      (1) Main texts:

         Lyons, Stephen (ed.), <u>Sun! A Handbook for the Solar Decade</u> (San Francisco: Friends of the Earth, 1978).

         Sawhill, John C. (ed.), Energy! <u>Conservation and Public Policy</u> (Englewood Cliffs, N.J.: Prentice-Hall Spectrum Book, 1979).

         Stobaugh, Robert, and Daniel Yergin (eds.), <u>Energy Future</u> (New York: Random House, 1979).

         Warkov, Seymour, (ed.), <u>Energy Policy in the United States: Social and Behavioral Dimensions</u> (New York: Praeger Publishers, 1978).

(2) Additional readings: on a session-to-session basis at the discretion of the instructor

3. Student projects

a. Assignment:

Assume that the following directive is issued by the chief executive of a city or county to all departments and agencies: "To more effectively manage the use of energy in our community, each department or agency director shall designate an energy coordinator within that unit. Within three months, each department or agency shall submit a plan specifying the broad energy management policies it will adopt and the specific energy management programs it will implement during the following year. The goal of these policies and programs will be to reduce the consumption of energy from nonrenewable sources by at least 20 percent within each unit's area of responsibility." Each student in the course will select or be assigned a department or agency in local government, and assume that he/she has been appointed the energy coordinator for that unit. The student is to prepare a position paper that (1) recommends energy management policies and programs for the unit to adopt; (2) indicates the potential benefits and problems that will result from each policy and program; and (3) suggests viable strategies for enacting those policies and programs.

b. Schedule:

(1) By the second session: select a department or agency

(2) By the fourth session: become familiar with that unit

(3) By the sixth session: submit a preliminary outline of the paper

(4) By the eighth session: submit a detailed outline of the recommended policies and programs and their benefits and problems (but not implementation strategies)

(5) Within a week after the tenth session: submit the final paper

(6) Optional eleventh class session: each student present an oral summary of his/her paper

c. Illustrations of analogous processes in which government units must achieve specified goals that are not directly related to their primary mission:

(1) Environmental Impact Statements: to protect the natural and social environments

(2) Affirmative Action Programs: to promote employment of minority persons and women

B. Basic Energy Concepts

1. Common energy terms and their definitions

    a. See list of terms and definitions in Attachment 1-B

    b. Discuss these terms as needed by the students

2. Energy units and conversions

    a. See units and conversion ratios in Attachment 1-C

    b. Show students how to use the table

3. U.S. energy consumption by type of fuel, 1948-1978

    a. See chart in Attachment 1-D

    b. Show students how to read the chart

4. U.S. energy consumption by end-use sector, 1948-1978

    a. See charts in Attachments 1-E and 1-F

    b. Show students how to read the chart

5. Total energy flow in the U.S. in 1970

    a. See figures in Attachment 1-G

    b. Show students how to read the figures

REFERENCES

A. Required Texts: none

B. Student Handouts:

Urban Energy Management Course Outline (1-A)
Common Energy Terms (1-B)
Energy Units and Conversion Ratios (1-C)
U.S. Energy Consumption by Type of Fuel (1-D)
U.S. Energy Consumption by End-Use Sector (1-E)
U.S. Energy Consumption by End-Use Sector and Subsection (1-F)
Total Energy Flow in the U.S. (1-G)

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SESSION 2. THE ENERGY PROBLEM

Instructor Outline

A. History of Energy Use: See Attachment 2-A

1. Emergence of energy as a commodity
   a. Coal
   b. Petroleum
   c. Natural gas
2. Theories of resource development
   a. Market theory
   b. Resource theory
   c. Growth theory
3. Governmental regulation of energy
   a. Sherman and Clayton Antitrust Acts
   b. State control agencies
   c. Federal Power Commission
   d. National Environmental Policy Act

B. U.S. Energy Trends During 1950-1973

1. Growth in energy consumption per capita
   a. Average of 5.5% per year
   b. Total increase of over 200% during the period
2. Decline in real energy prices
   a. Average of -1.8% per year
   b. Total decline of -30% per year during the period
3. Ratio of energy demand to Gross National Product
   a. Relatively constant for the U.S. during the period
   b. U.S. ratio much higher than all other countries (except Canada)

<u>C. Current Energy Sources</u>: See Stobaugh and Yergin, <u>Energy Future</u>

1. Oil
2. Natural gas
3. Coal
4. Nuclear energy

<u>REFERENCES</u>

A. <u>Reading Assignments from Required Texts</u>:

<u>Energy Future</u>, Chaps. 1-5
<u>Sun!</u> pp 185-195

B. <u>Student Handout</u>: (provided in Section III)

William Brewer, <u>History of Energy Use</u> (2-A)

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SESSION 3. NATIONAL ENERGY POLICIES AND PROGRAMS

Instructor Outline

A. Alternative Energy Policy Perspectives

1. Four different perspectives: See Attachment 3-A

   a. High technology, or the "historical growth" scenario

   b. Energy efficiency, or the "technical fix" scenario

   c. Appropriate technology, or the "conservation/solar" scenario

   d. Societal transformation, or the "small is beautiful" scenario

2. Amory Lovins' two energy paths: See Suggested Readings.

   a. The hard energy path

   b. The soft energy path

   c. Transition technologies and policies

B. Federal Energy Legislation Since 1974

1. Major legislation between 1974-1977

   a. Solar Energy Research and Demonstration Act (Public Law 93-473; October 1974)

      (1) Provided for the creation of the Solar Energy Research Institute, which together with its four regional commercialization centers is dedicated to the advancement of solar technologies and their rapid adoption in the private sector.

      (2) Many activities of SERI and the regional centers are oriented toward communities, such as the First Annual Conference on Community Renewable Energy Systems in August 1979.

   b. Energy Policy and Conservation Act (Public Law 94-163; December 1975)

      (1) This first comprehensive energy policy law established a mechanism for adopting and implementing a gasoline rationing plan.

      (2) Established a basis for oil price regulation (and phased deregulation) and oil allocation programs.

      (3) Established energy efficiency regulations applicable to automobiles, appliances, and industries.

(4) Facilitated the establishment of state-level conservation programs that covered building and lighting standards, procurement practices, traffic control, and carpool/vanpool programs.

c. Energy Conservation and Production Act (Public Law 94-385; August 1976)

(1) Provided for supplemental state conservation programs that include public information and energy audits.

(2) Called for setting energy conservation standards for new buildings.

(3) Provided financial assistance for residential weatherization by low-income homeowners.

d. Electric Vehicle Research, Development, and Demonstration Act (Public Law 94-413; September 1976)

(1) Nine state and local government units are participating in cost sharing agreements under this electric and hybrid vehicle demonstration project.

e. National Energy Extension Service Act (Title V of Public Law 95-39; June 1977)

(1) Established a locally oriented public information, education, and technical assistance program for small scale energy users.

(2) Emphasizes energy conservation and renewable energy resources.

2. The National Energy Act of 1978: See Attachment 3-B

a. Public Utilities Regulatory Policies Act (Public Law 95-617; October 1978)

(1) Established guidelines for the design of natural gas and electric rates and for non-rate-related utility practices such as master metering.

(2) Provided incentives for cogeneration and small-scale hydroelectric facilities.

b. Energy Tax Act (Public Law 95-618; October 1978)

(1) Established income tax credits for investments in residential energy conservation and renewable resource actions.

(2) Removed federal excise taxes on gasohol, buses, and bus parts.

(3) Created tax incentives for van pooling.

(4) Increased the business tax credit for investments in conservation and solar technologies.

c. National Energy Conservation Policy Act (Public Law 95-619; October 1978)

(1) Required utilities to establish conservation programs for their residential customers.

(2) Established conservation and solar loan programs.

(3) Provided funding for projects to improve the energy efficiency of schools, hospitals, and public buildings.

d. Power Plant and Industrial Fuel Use Act (Public Law 95-620; October 1978)

(1) Established rules to discourage or prohibit the use of petroleum or natural gas in certain industrial and electric power plant applications.

(2) Prohibited the use of natural gas for outdoor decorative lighting.

e. National Gas Policy Act (Public Law 95-621; Octover 1978)

(1) Established a schedule for the phased deregulation of natural gas prices.

3. Energy Legislation of 1979

a. Department of Energy Standby Conservation Plan 2 (S.Res. 122, H.R.Res. 209)

(1) President Carter's plan to order restrictions on thermostat settings in non-residential buildings.

b. Emergency Energy Conservation Act (S.1030)

(1) After Congress rejected the gasoline rationing plan submitted by President Carter in compliance with EPCA, it developed its own plan, which was passed by both the Senate and the House in different forms during 1979.

(2) Also authorizes the establishment of emergency conservation targets and plans for each state.

c. Energy Management Partnership Act (S.1280)

(1) Consolidates and elaborates state energy activities authorized under EPCA, ECPA, and the Energy Extension Service Act.

(2) Provides financial assistance to states to develop and implement state energy plans and specifies the basic elements of those plans.

(3) Authorizes states to transfer portions of their federal funding for energy planning to local governments.

d. Community Energy Efficiency Act and Local Energy Management Act (overlapping bills that will be combined)

(1) Authorizes federal funding through HUD to create Local Energy Offices in major cities and counties that would develop and implement community energy conservation and renewable resource programs.

(2) Authorizes federal funding through DOE to local communities for energy related public capital improvements.

(3) Calls for the establishment of Citizen's Commissions in each community to work with the Local Energy Office.

(4) Encourages communities to establish a Citizen's Conservation Corps to assist the Local Energy Office in implementing conservation and renewable resource programs.

(5) Authorizes funding for Local Energy Reference Centers, regional Technical Assistance Panels, and information Documentation and Distribution Grants to communities.

e. Priority Energy Project Act (S.1308)

(1) Calls for the establishment of an Energy Mobilization Board to speed decision-making on priority energy projects.

(2) The Board could override procedural rules and possibly environmental and other substantive laws that might impeed energy development

f. Crude Oil Windfall Profit Tax Act (H.R.3919)

(1) Provides funding for a variety of energy conservation programs.

(2) Funds would come from a windfall profits tax on oil companies.

C. Current Federal Energy Policy Proposals

1. Explain, discuss, and evaluate whatever policy proposals have recently been made by federal officials.

REFERENCES

A. Reading Assignments from Required Texts:

Energy Conservation and Public Policy, Chaps. 1,3
Sun!, pp 9-67

B. Student Handouts:

Alternate Energy Policy Perspectives (3-A)
U.S. Dept. of Energy, A New Start: the National Energy Act (3-B)

C. Suggested Readings:

Lovins, Amory, 1977. Soft Energy Paths: Toward a Durable Peace, Cambridge: Ballinger, p. 25-60.

SESSION 4. STATE AND LOCAL ENERGY PROGRAMS

Instructor Outline

A. Funding Sources for State and Local Programs

1. Federal government funding programs: See Attachment 4-A

   a. Department of Energy

   b. Department of Housing and Urban Development

   c. Department of Transportation

   d. Other departments

2. Pending programs (see Session 3 notes)

   a. Community Energy Efficiency Act

   b. Local Energy Management Act

3. Unsolicited proposals to government agencies

   a. Most federal offices have some discretionary funds to support programs that are directly relevant to their mission.

   b. Most effective way of locating and obtaining such funds is by developing personal contacts with individuals within all relevant offices.

B. State Energy Programs

1. Suggested teaching procedure

   a. Describe the state energy situation, energy office, and energy management activities of the state in which the course is being offered, following the example for Washington State given below.

   b. Then contrast that state with California, which has one of the most extensive and vigorous state energy management programs.

2. Washington State energy management

   a. State energy situation

      (1) State energy inputs and outflows: See Attachment 4-B

      (2) Projected future energy demands: See Attachment 4-C

      (3) Predicted future electricity costs: See Attachment 4-D

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b. State energy office

(1) Location within the state government

(2) Nature and size of the professional staff

(3) Organized into three main branches:

(a) Conservation
(b) Research management
(c) Contingency planning

c. State energy policy and programs

(1) Policy statements in state legislation

(2) Goal of the Washington State Energy Conservation Plan is to reduce total energy consumption in the state by 5 percent per year below the projected level (which assumes a 4 percent annual growth rate) for 1985.

(3) Specific program measures, costs, expected energy savings, and cost/benefit ratios: See Attachment 4-E

(4) Evaluation of the state energy programs

3. California Energy Resources Conservation and Development Commission

a. Commission structure and responsibilities

(1) Consists of five Commissioners appointed by the Governor with the concurrence of the state legislature for five-year terms, which gives the Commissioners considerable freedom from political pressures.

(2) Has a large staff of professional energy experts from many different fields.

(3) Has total responsibility for all energy planning and decision making in the state, so can take an integrated approach to all energy issues.

(4) Specific responsibilities include energy demand forecasting, energy supply analysis, site evaluation, energy use regulation, energy standard setting, alternative energy supply studies, energy conservation promotion, and solar energy development.

b. Policies and programs

(1) The state legislature has adopted the policy that conservation is a major energy source, to be given highest priority, with the goal of reducing total energy consumption in the state by 20% by 1985.

(2) The state is officially committed to promoting solar energy as fully as possible.

(3) The state gives a credit against the state income tax for 55 percent of the total cost for solar additions and related conservation actions on buildings, up to $3000.

(4) The Commission conducts a wide array of vigorous programs promoting energy conservation and solar energy.

(5) The Commission publishes numerous reports on current and expected future energy conditions, such as "Energy Choices for California: Looking Ahead" and "Toward an Alternative Energy Path for California."

C. <u>Local (city and county) Energy Programs</u>

1. Suggested teaching procedure

   a. To illustrate the kinds of energy management programs presently being conducted in local communities across the country, review the report "Local Government Energy Activities" issued by the U.S. Department of Energy in 1979.

   b. In that review, examine Seattle as one of the most extensive community energy conservation programs in the nation.

   c. Although Davis, California, is not included in the DOE report, also examine its far-reaching community energy conservation program.

   d. Then sketch whatever energy management programs are presently being conducted in the community in which the course is being offered.

2. Seattle, Washington

   a. Excerpts from "Local Government Energy Activities" concerning Seattle: See Attachment 4-F

   b. Energy conservation programs being conducted by Seattle City Light: See Attachment 4-G

3. Davis, California

   a. Review the booklet "The Davis Experiment," available from The Elements, 1747 Connecticut Ave., Washington, D.C. 20009, at $2 per copy.

4. Community in which the course is given

5. Policy making in local government

a. The pluralistic character of the American political process

(1) Economic (business and labor) and ideological or public interest groups are very influential in legislative, administrative, and judicial outcomes.

(2) These outcomes are generally bargained out among diverse groups that are interested in a piece of legislation.

b. The relationship of pluralism to incremental development

(1) As a result of the pluralistic structure of American politics, decision making in our system is usually incremental.

(2) This process discourages planned comprehensive reform or change, and favors small adjustments to systems and programs that tend to improve or refine those systems at their most noticeably deficient points.

c. Applicability of pluralism to local government

(1) There is considerable evidence that economic dominants (industry and commerce) exert disproportionate amounts of political power in some communities (e.g., small towns, one-industry towns),

(2) But on the whole, local government is affected by the same kinds of pulls and tugs of the pluralistic process as occur at the national level.

(3) Many different groups exert influence on local government at different times, depending on the issue area.

d. Applicability of pluralism to incremental decision making in research and development

(1) In the field of research and development, non-incremental decision making has frequently occurred.

(2) Because of such factors as national security concerns, lack of organized interest groups (other than scientists), and lack of public understanding, most major research and development decions (e.g, commercialization of the atom, major military systems, the Appollo program) have been more like planned comprehensive interventions than bargained-out marginal adjustments.

(3) This situation has been changing in recent years because of the more wide-spread impact of science and technology on the environment, and greater public understanding of ecology.

e. Illustrations of the way in which the fragmented and pluralistic nature of the U.S. political system has affected energy policy making at the national level: See Suggested Reading: Freeman.

D. Citizen Participation in Energy Management

1. General principles of citizen participation: See Suggested Reading: Washnis.

   a. Influence of citizen participation on government

      (1) A continuum ranging from citizen committees that are totally coopted by local government, to Alinski-type confrontation groups and citizen governing boards.

      (2) Many forms and degrees of influence and effectiveness along this continuum.

   b. Types of citizen intervention

      (1) Delaying or stopping projects that are seen as having detrimental impact on a community.

      (2) Establishing broad goals for a community.

      (3) Developing specialized policies in select issue areas.

      (4) Legitimizing decisions already made by a government agency.

      (5) Identifying programmatic options within a specific problem area.

      (6) Investigating government scandals or highly controversial issues.

      (7) Supporting or opposing an initiative or referendum in an election.

2. Citizen participation and energy policy

   a. In general, communities that have established relatively comprehensive and integrated energy management programs also have strong citizen participation emphases (e.g., Seattle, Wash., and Portland, Ore.).

   b. The reason for this may be that public officials are often hesitant to move far into the new area of energy policy unless they feel they have strong support from citizen groups.

   c. The actions that local governments can take by themselves to manage energy are rather limited, so that if such programs are to be very effective the government must elicit the active cooperation of many private groups and organizations in the community.

3. Case study: Seattle City Light Energy 1990 Report

a. Background

(1) Seattle is governed by a strong Mayor/Council system that gives the Mayor effective authority over all department heads, and the City Council a substantial role in policy formation.

(2) The electric utility is publicly owned.

(3) The environmental movement is very strong.

b. The process

(1) The Energy 1990 study process was initiated when Seattle City Light requested approval from the City Council to purchase 10% of the output of a proposed nuclear reactor at a cost of 250 million dollars.

(2) The City Council subsequently purchased an option to buy the nuclear power.

(3) The Washington Environmental Council then filed a law suit requesting that an Environmental Impact Statement be written before any decision was made on the nuclear purchase.

(4) As a result of the suit, City Light organized a citizen's committee to work with the professional consultant in preparing the Environmental Impact Statement.

(5) The citizen's committee worked for approximately a year, examining all aspects of Seattle's electrical power situation.

(6) In its final report, Energy 1990, the committee reccommended neither acceptance nor rejection of the proposed nuclear purchase. Instead, it proposed a substitute plan calling for a series of energy conservation measures designed to save approximately the same amount of electricity that would have been purchased under the original plan.

(7) The City Council subsequently adopted the policy of not purchasing any additional electrical generating capacity for the city, but instead relying on conservation to meet all future electrical demand.

c. Evaluation

(1) Three factors that were very significant in this process:

(a) The environmental impact process provided a useful means of requiring an examination of alternatives to the initial plan.

(b) Involvement of the citizen's committee assured that the entire process remained fully open, which contributed to both the quality of the final report and public confidence in and support for it.

(c) The interaction between the City Council and City Light was constructive, in that it brought differing perspectives to bear on the problem and insured that all relevant alternatives were examined.

(2) Limitations to the Energy 1990 process

(a) Lack of continuity. The report is already out of date because Seattle has grown at a faster rate than predicted, so that the entire process may have to be repeated soon.

(b) There was no real bargaining in the traditional pluralistic sense. Both business and environmental groups were represented on the citizen committee, but the "neutral" members all sided with the environmentalists and simply outvoted the business representatives on the committee.

REFERENCES

A. Reading Assignments from Required Texts:

Energy Conservation and Public Policy, Chap. 11
Sun!, pp 287-294
Energy Policy in the United States, Chaps. 1,14

B. Student Handouts:

Funding Sources for Energy Related Projects for State and Local Government Agencies, Organizations, Business, and Individuals (4-A)
Energy Flow Diagram - State of Washington (4-B)
Various Forecasts of Growth in Demand for the Pacific Northwest (4-C)
Predicted Future Electricity Rates in Washington State (4-D)
Program Measures of the Washington State Energy Office (4-E)
U.S. Department of Energy 1979. Excerpts Concerning Seattle from "Local Government Energy Activities." (4-F)
Seattle City Light, Office of Conservation Program Activities (4-G)

C. <u>Suggested Reading</u>:

Freeman, David S. 1974. *Energy: The New Era*. New York: Random House, pp 158-176

Washnis, George J. "Community Involvement. . .Why?" *Public Management*, December, 1975.

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SESSION 5. TECHNIQUES OF ENERGY PLANNING

Instructor Outline

A. Energy Demand Forecasting: See Attachment 5-A

1. Rationale for demand forecasting

   a. High costs of over- and under-building

      (1) Important in direct proportion to the cost of inappropriate energy development

      (2) Costs of premature development

      (3) Costs of late development

   b. Long lead-times for resource development

      (1) High probability of inaccuracy in forecasting

      (2) Results from long lead-times for constructing new production facilities

2. Methods of demand forecasting

   a. Trending

      (1) Principle of extrapolation, with modifications

      (2) Assumptions of the method

         (a) Future economic and demographic conditions will remain the same

         (b) Consumers will continue to react in the same way to economic and demographic conditions

      (3) Appropriate applications

         (a) When both assumptions are satisfied

         (b) When the costs of error are low

         (c) When require an inexpensive procedure

         (d) When the situation requires little policy guidance

   b. Econometrics

      (1) Statistical analysis of each component variable

      (2) Assumptions of the method

(a) That people's responses to conditions will remain the same

(b) Does not assume that those conditions will remain constant

(c) Availability of considerable statistical data

(3) Appropriate applications

(a) When the costs of error dictate an accurate forecast

(b) When future conditions are expected to change markedly

(c) For estimating impacts of alternative policies

c. End-use analysis

(1) Disaggregated econometric forecasting

(2) Calculating energy requirements based on the physical requirements of each end-use sector

(3) Assumptions of the method

(a) About typical engineering characteristics

(b) How these will change in response to economic factors

(4) Appropriate applications

(a) Inappropriate for prediction because it requires broad, unverified assumptions about consumer responses

(b) Useful for setting goals or limits for energy use

d. Input-output analysis

(1) Reconstructs inputs and outputs of each sector of the economy

(2) Works backward from an assumed amount and mix of outputs to determine their energy input requirements

(3) Assumptions of the method

(a) Requires a great deal of data that often is not available

(b) Static input-output relationships in the sectors

(4) Appropriate applications

(a) A poor forecasting technique because of its static nature

(b) Can estimate the effects of energy on enployment

B. Energy Economics and Pricing: See Attachment 5-B, Suggested Reading: Freeman

1. Guidelines for energy pricing

   a. Natural monopolies

      (1) Necessity for monopolies

      (2) Means of controlling monopolies

         (a) Public ownership

         (b) Government regulation

      (3) Average cost pricing

   b. Cost of service

      (1) Institutionalizes average cost pricing

      (2) Establishes a basis for price discrimination

   c. Joint outputs

      (1) Three requirements of electricity

         (a) Accessible

         (b) Total capacity

         (c) Peak demand

      (2) Separate pricing considerations

2. Effects of pricing guidelines

   a. On allocation of resources

      (1) Price elasticities for energy

      (2) Possibilities

         (a) Rising prices retard demand

         (b) Use of price as a policy tool

         (c) Overdevelopment of expensive new resources

   b. On distribution of energy among customers

      (1) If costs for a group are underestimated

         (a) A cost break

         (b) Increased consumption

(2) Potential policy actions

(a) Influence employment mix

(b) Redistribute incomes

(c) Alter energy consumption levels

3. Problem in energy pricing

a. Inefficiency of average cost pricing

(1) No information about cost of new resources

(a) If cheap, leads to under-development

(b) If expensive, leads to over-development

(2) Marginal-cost pricing

b. Revenue imbalances

(1) With marginal cost pricing:

(a) Too little revenue if new units are cheap

(b) Too much revenue if new units are expensive

(2) Remedies:

(a) Inadequate revenues: a subsidy

(b) Surplus revenues: a rebate process

c. Planning-pricing paradox

(1) When new resources are expensive, average cost pricing leads to over-development

(a) Additional cost depresses consumption below capacity

(b) But without the development, shortages occur

(2) Marginal cost pricing

(a) Unstable

(b) Surplus revenues and redundant capacity

(3) Long-Run Incremental Cost pricing

REFERENCES

A. Reading Assignments from Required Texts:

Energy Conservation and Public Policy, Chap. 2
Energy Policy in the United States, Chap. 12

B. Student Handouts:

John Gibson,"Energy Demand Forecasting" (5-A)
John Gibson,"Energy Economics and Pricing" (5-B)

C. Suggested Reading:

Freeman, David S. 1974. Energy: The New Era. New York: Random House. p. 138-57

SESSION 6. TECHNIQUES OF ENERGY CONSERVATION

Instructor Outline

A. Principles of Energy Conservation: See Attachment 6-A

1. Characteristics of energy usage
    a. Role of energy in modern society
    b. Measuring energy consumption
        (1) Energy intensiveness of an activity
        (2) Extent of that activity
    c. Technological change versus social change
2. Determinants of energy usage
    a. Price of labor and associated capital costs
    b. Convenience of use
    c. Climate and other geographical factors
3. Definitions of energy conservation
    a. Reduction in the consumption of energy
    b. Reduction in the consumption of non-renewable resources
    c. Improved efficiency in energy use
4. Opportunities for energy conservation
    a. Reducing energy intensiveness in existing systems:
        (1) Leak plugging
        (2) Improved maintenance
        (3) Altered use patterns
        (4) Modification of the system
    b. Reducing energy intensiveness in new systems:
        (1) Alternative technologies
        (2) New technologies

B. Energy Conservation in Buildings: See Attachment 6-B

1. Space heating

   a. Energy use patterns in residential and commercial buildings

      (1) Degree days

      (2) Heat loss calculations

   b. Heat loss processes

      (1) Conduction

      (2) Convection

      (3) Infiltration

   c. Conservation techniques in buildings

      (1) Reducing the amount of exterior surface area

      (2) Using better building materials

      (3) Creating dead-air spaces

      (4) Using new building techniques

   d. Heat gain in buildings

      (1) Body heat from occupants

      (2) Heat from lighting and appliances

      (3) Solar radiation through windows

      (4) Space heating systems

         (a) Furnaces

         (b) Heat pumps

   e. Integrated systems in commercial buildings

   f. Potential energy savings in buildings through conservation

2. Appliances, equipment, and lighting

   a. Current development of more efficient household equipment

   b. Current development of more efficient commercial equipment

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C. <u>Energy Conservation in Transportation</u>: See Attachment 6-C

1. Energy use for transportation in urban areas

   a. Distribution of energy consumption by type of transportation

      (1) Automobile

      (2) Freight

      (3) Bus

      (4) Rail

   b. Calculation of energy consumption by automobiles

      (1) Total energy consumption

      (2) Energy intensiveness components

      (3) Extent of activity components

      (4) Further break-downs

2. Local transportation conservation measures

   a. Three key factors

      (1) Reducing the number of passenger-trips by automobile

      (2) Reducing average trip lengths

      (3) Increasing occupancy levels

   b. Specific actions available to local governments

      (1) Procurement and maintenance programs for government cars

      (2) Mandatory inspection programs

      (3) Strategies to improve traffic flow

   c. Electric cars

      (1) Opportunities for conservation

      (2) Potential problems

<u>D. Energy Conservation in Industry</u>: See Attachment 6-D

1. Energy use by industry

    a. Distribution of energy consumption by industry among end-uses

        (1) Steam

        (2) Direct heat

        (3) Electric drive

        (4) Feedstock

        (5) Electrolytic processes

    b. Calculation of energy consumption by industry

        (1) Energy intensiveness components

        (2) Extent of activity components

2. Current technological needs and prospects

    a. More efficient furnaces, boilers, and heat recovery devices

    b. Improved electric motor efficiencies

    c. Computerized control systems for regulating industrial processes

    d. Recycling, recovery, and reuse of materials

3. Local community potentials

    a. Synergistic arrangements in which high temperature waste heat from one company is used to meet low-temperature requirements of other companies.

    b. Combined on-site production of steam and electricity (co-generation) for a factory or an entire complex of facilities.

    c. Technical assistance and financial incentives for small industries to practice energy conservation.

REFERENCES

A. Reading Assignments from Required Texts:

Energy Future, Chap. 6
Energy Conservation and Public Policy, Chaps. 4-6

B. Student Handouts:

Barry Hyman, "Principles of Energy Conservation"(6-A)
Barry Hyman, "Energy Conservation in Buildings" (6-B)
Barry Hyman, "Energy Conservation in Transportation (6-C)
Barry Hyman, "Energy Conservation in Industry" (6-D)

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SESSION 7. TECHNIQUES OF RENEWABLE ENERGY PRODUCTION

Instructor Outline

A. Principles of Renewable Energy Production

1. Concepts
    a. Renewable energy resources
    b. Solar energy
2. Types of renewable resources
    a. Biological matter
    b. Solar radiation
    c. Water flow and temperature
    d. Wind
3. Characteristics of renewable resources
    a. Extent
    b. Distribution
    c. Quality
    d. Energy potential
4. Local management of renewable resources
    a. Relevant national policies
    b. Possibilities for local action
    c. Limitations and barriers to local action

B. Substitute Fuels: See Attachment 7-A

1. Municipal wastes
    a. Feasibility of use
    b. Composition
    c. Techniques for converting to energy
        (1) Incineration

(2) Pyrolysis

(3) Bioconversion

2. Other sources

a. Forest products and wastes

b. Agricultural crops and wastes

<u>C. Direct Solar Heating</u>: See Attachment 7-B

1. Passive solar heating

a. Concept

b. Techniques

c. Effectiveness

d. Barriers to adoption

e. Costs

2. Active solar heating

a. Process

b. Equipment

c. Advantages

3. Solar water heating

a. Present extent of use

b. Feasibility

<u>D. Electricity Generation</u>: See Attachment 7-C

1. Technologies using renewable resources

a. Solar thermal electric power

(1) Technology

(2) Feasibility

b. Photovoltaics

(1) Technology

(2) Feasibility

c. Wind

(1) Technology

(2) Siting

2. Other technologies

a. Fuel cells

(1) Technology

(2) Feasibility

b. Cogeneration

(1) Technology

(2) Feasibility

c. Total energy systems

(1) Technology

(2) Efficiency

3. Advantages and disadvantages

a. Advantages

b. Limitations

c. Policy issues

REFERENCES

A. Reading Assignments from Required Texts:

Energy Future, Chaps. 7,8
Energy Conservation and Public Policy, Chaps. 8,9
Sun!, pp 147-169, 226-253

B. Student Handouts:

Barry Hyman, "Substitute Fuels" (7-A)
Barry Hyman, "Direct Solar Heating" (7-B)
Barry Hyman, "Electricity Generation" (7-C)

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SESSION 8. STRATEGIES FOR VOLUNTARY ENERGY MANAGEMENT

Instructor Outline

A. Introduction to Implementation Strategies: See Attachment 8-A

1. A theoretical perspective

   a. The situation: Individual rational action leads to collective ruin -- the "tragedy of the commons."

   b. The challenge: How to induce individuals to act counter to their short-run personal interests to contribute to the long-term collective good -- the "logic of collective action."

   c. Three solutions to the logic of collective action:

      (1) Voluntary contributions based on trust

      (2) Selective incentives as supplements to the public good

      (3) Coercion

2. The contexts of energy consumption

   a. Concept: patterns of energy consumption are determined by a complex process of interaction among numerous factors in several different (but interrelated) contexts:

   b. Major contexts:

      (1) Technical: community design, building construction, vehicles, appliances, transit systems, etc.

      (2) Economic: income levels, consumption patterns, cost of living, energy prices, billing practices, etc.

      (3) Government: utility regulations, building and appliance standards, zoning laws, government policies, etc.

      (4) Communication: energy information, product and image advertising, awareness of energy, stance of leaders, etc.

      (5) Social: interpersonal interaction, neighborhood and organizational actions, community programs, etc.

      (6) Personal: values, perceptions, beliefs, knowledge, experience, sociodemographic characteristics, etc.

3. Strategies for implementing change

   a. Goal determination

(1) Alternative objectives

(a) Use energy more efficiently

(b) Modify energy consuming behavior

(c) Utilize energy from renewable sources

(d) Change lifestyles or social structures

(2) Areas of energy use

(a) Buildings, especially space conditioning

(b) Transportation, e specially private vehicles

(c) Industrial, especially energy intensive processes

(3) Specific change targets: cross-classify objectives with use areas to select specific targets for change efforts

b. Instrument selection

(1) Voluntary techniques

(a) Persuasion and information

(b) Social organization and mobilization

(2) Financial techniques

(a) Price and tax manipulation

(b) Incentives and disincentives

(3) Mandatory techniques

(a) Regulations and requirements

(b) Redesign and planning

c. Action identification

(1) Within each energy consumption context, identify those those factors that are manipulable.

(2) Cross-classify those manipulable implementation factors with available implementation instruments.

(3) Within each cell of this matrix, identify specific possible actions to take.

4. Criteria for the implementation process

a. SAM goals: set goals that are Specific, Attainable, and Measurable.

b. REF instruments: select instruments that are Realistic, Effective, and Feasible.

c. POC programs: develop action programs that are Precise, Organized, and Coherent.

d. RAC effects: monitor short-term program effects in terms of public Resistance, Acceptance, and Committment.

e. RIC outcomes: evaluate long-term program outcomes in terms of people's Responses, environmental and social Impacts, and energy Consumption.

B. Principles of the Voluntary Approach

1. Purpose: To induce individuals to voluntarily adopt new patterns of action.

2. Two forms:

   a. Information

   b. Mobilization

3. Desirable features

   a. Relatively inexpensive and easy to implement

   b. Does not require surveillance or sanctions

   c. Not likely to arouse public opposition

4. Undesirable features

   a. Difficult to direct and control

   b. Relatively ineffective by itself

C. Information Techniques

1. Main characteristics

   a. Intention: To change individuals' knowledge and attitudes, so that they will become committed to a new course of action.

   b. Theory: Rests on psychological theories of change. Assumes that cognitive and attitudinal change will produce behavioral change.

c. Instruments:

(1) Information about the energy problem and ways of coping with it.

(2) Persuasive and normative appeals to adopt new attitudes and actions.

d. Techniques

(1) Problem awareness

(2) Technical information

(3) Consumption feedback

2. Problem awareness

a. Characteristics

(1) Attempts to make people more aware of the nature, extent, and seriousness of the energy problem, in hopes that they will then want to take conservation actions.

(2) Messages vary from statistical data to emotional appeals.

b. Effectiveness

(1) All available evidence indicates that belief in the reality and seriousness of the energy problem is unrelated to taking conservation actions.

(2) Such beliefs may make people more willing to support proposed governmental conservation policies, but policy support is not directly linked with taking personal actions.

(3) More important may be holding broad values such as "ecological awareness" or a "conservation ethic," but such values are also unlikely to result in conservation actions unless the person internalizes them as a felt personal obligation to help solve the energy problem.

(4) Feeling a personal obligation or duty to help conserve energy is one of the most common reasons given by people for taking conservation actions, but it is not clear whether this is a true motive or only a public justification.

3. Technical information: See Suggested Readings: Craig, McCann, Winett, et.al.

a. Characteristics

(1) Gives people specific technical information about actions they can take or equipment they can use to save energy.

(2) May also include information about the potential monetary and/or energy savings that can result from the recommended steps.

b. Effectiveness

(1) Technical information is absolutely necessary, since without it most people have little or no idea of what to do to conserve energy.

(2) If people are already committed to saving energy, they will usually welcome and utilize such information.

(3) If people are not already so committed, they will very likely ignore such information or fail to use it.

(4) In short, technical information, by itself, is a necessary but not sufficient means of promoting energy conservation.

4. Consumption feedback: See: Winett

a. Characteristics

(1) Consumers are given daily or weekly feedback on their current energy (primarily electricity) consumption.

(2) This consumption data is compared to a pre-established goal, previous consumption levels, or other consumers.

(3) DOE is presently testing a home electric meter that gives continual consumption readings, both in kilowatts and cents.

b. Effectiveness

(1) Early experiments reported reductions of 10% to 20% for short periods of time, primarily with air conditioning reductions.

(2) Later studies have reported no savings over time, especially when feedback was combined with financial incentives for reducing consumption.

(3) The usefulness of this procedure is now in doubt, especially considering the practical problems of providing continual feedback to large numbers of people.

5. Evaluation of information techniques

   a. Awareness of the energy problem and development of a conservation ethic help to create a climate of public opinion favorable to conservation policies and programs, and may also legitimize and reinforce people's intentions to take conservation actions, but they do not directly produce such actions.

   b. Technical information about conservation procedures is vital, once people are motivated to practice conservation, but it is not sufficient by itself.

   c. Feedback about energy consumption can be useful to people who are seeking to reduce their consumption, but it will not by itself induce people to take such actions.

D. Mobilization Techniques

1. Main characteristics

   a. Intention: To place people in social contexts in which new actions (such as energy conservation) are occurring, to induce them to adopt those actions.

   b. Theory: Rests on interpersonal theories of influence and change. Assumes that individuals change their actions in response to pressures received from salient others.

   c. Instruments

      (1) Interpersonal pressures in informal social settings

      (2) Interpersonal pressures in formal social organizations

   d. Techniques

      (1) Neighborhood activities

      (2) Organizational actions

      (3) Community programs

2. Neighborhood activities: See Attachment 8-B

   a. Characteristics

      (1) A study done after the 1974 oil embargo discovered that a major factor determining whether or not people took conservation actions was the extent to which their neighbors were making such efforts.

      (2) The neighborhood context can be used by agencies seeking to promote energy conservation, as in the Seattle City Light Neighborhood Energy Conservation Program

(3) Neighborhood activities can include informal gatherings, block and neighborhood workshops, programs in neighborhood schools, etc.

b. Effectiveness

(1) Available evidence suggests that such activities can provide an effective channel for communicating technical and other information.

(2) The people who attend these activities are likely to be already interested in energy management, but the social reinforcement received in the activities will probably strengthen their resolve to take action.

(3) Do not presently know whether such activities, if extensive and intensive enough, can induce previously uninterested persons to adopt new conservation actions.

3. Organizational actions

a. Characteristics

(1) There is considerable research evidence that people can be mobilized to take part in new practices if local organizations to which they belong or which they respect adopt and promote those practices.

(2) Such organizations include businesses, schools, churches, and interest associations.

(3) An illustration: the Boeing Company instituted an energy conservation program that resulted in a 30% reduction in energy consumption by the company in one year, and that also encouraged employees to adopt similar practices at home.

b. Effectiveness

(1) Case examples such as Boeing suggest that this technique can be quite effective.

(2) Presently do not have systematic quantitative data on the effectiveness of this technique.

4. Community programs: See Attachment 8-C

a. Characteristics

(1) If an entire community adopts a goal such as conserving energy and establishes programs to achieve it, this can also motivate people to begin practicing those changes in their own lives.

(2) Some of these programs, such as the Energy Extension

(2) Some of these programs, such as the Energy Extension Service, rely primarily on information techniques.

(3) Other community efforts, such as that being made by Davis, California, combine information techniques with mandatory regulations and requirements: See Suggested Reading, Session 10: McGregor.

b. Effectiveness

(1) To the extent that such programs do involve the entire community, cases such as Davis suggest that they can be extremely effective in promoting energy management.

(2) Presently do not have systematic quantitative data on the effectiveness of this technique.

5. Evaluation of mobilization techniques

a. Can be viewed as a way of applying the voluntary information approach more effectively, by reinforcing messages and appeals with interpersonal pressures and support.

b. To the limited extent that mobilization techniques have been employed, they appear to have been rather effective in promoting energy management practices.

c. These techniques clearly help to move people from the "intention" to the "action" stage, but it is not yet clear whether they can shift people from "opposed" or "apathetic" positions.

REFERENCES

A. Reading Assignments from Required Texts:

Energy Policy in the United States, Chaps. 8,1

B. Student Handouts:

Marvin Olsen and Bernward Joerges, Policies for Promoting Consumer Energy Conservation: An American-European Perspective, Seattle, WA: Battelle Human Affairs Research Center, March, 1979, 56pp. (8-A)

C. Suggested Reading:

Craig, Samuel C., and McCann, John, "Assessing Communication Effects on Energy Conservation" Journal of Consumer Research, Vol.5, Sept. 1978 pp. 82-87.

Winett, Richard A., et al. "Effects of Monetary Rebates, Feedback and Information on Residential Electricity Conservation" Journal of Applied Psychology, Vol.63 No.1, 1978.

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SESSION 9. STRATEGIES FOR FINANCIAL ENERGY MANAGEMENT

Instructor Outline

A. Principles of the Financial Approach

1. Purpose: To induce individuals to adopt new patterns of action by making it financially advantageous to do so.

2. Two forms:

   a. Pricing

   b. Incentives

3. Desirable features

   a. The traditional, accepted way for government to implement public policy in the U.S.

   b. Operates through the marketplace and does not require surveillance or sanctions by government

   c. Relatively easy to direct and control

4. Undesirable features

   a. Many aspects of individual and collective life are not affected by economic considerations.

   b. Some types of financial programs can be very expensive for government.

   c. Financial programs can have sharply inequitable effects for low-income people.

B. Pricing Techniques: See Suggested Reading: Willenborg, Pitts

1. Main characteristics

   a. Intention: To raise the price of energy enough so that people will reduce their energy consumption.

   b. Theory: Rests on economic theories of price elasticities, which state that as the price of a good increases, consumption of it will decrease at a relatively stable rate, at least in the long run.

   c. Instruments:

      (1) Energy prices

      (2) Energy taxes

d. Techniques

(1) Price degregulation

(2) Energy surtax

2. Price deregulation

a. Characteristics

(1) Can be used whenever the prevailing market price of any form of energy is above the price currently established or enforced by government.

(2) Involves removing price ceilings or other governmental restrictions that are keeping the price of energy below the prevailing international or national market level.

b. Effectiveness

(1) In the short run, energy is relatively inelastic because of the high cost and long life of energy using equipment such as cars and buildings.

(2) Especially in periods of rapid inflation, the price increases must be considerably greater than the rising cost of living, or consumers will ignore them.

(3) Many of the benefits of high energy use are so highly desired and valued by consumers that they will pay virtually any price to continue obtaining energy. This is particularly true with high-income people.

(4) Price increases can be grossly inequitable for low-income people, who already spend a large proportion of their income on energy and yet use only a minimally necessary amount and have no way of reducing their consumption without suffering greatly.

(5) Price increases are most effective at reducing energy consumption among middle-income people.

3. Energy surtax

a. Characteristics

(1) Government levies a tax on the final sale of all energy from non-renewable resources.

(2) If the revenues from this tax are redistributed equally to all citizens, the tax benefits low energy consumers and penalizes high energy consumers, regardless of their income level.

b. Effectiveness

(1) An energy surtax without a redistribution program is simply a technique for further raising the price of energy, and would be subject to all the limitations and inequities applicable to deregulation.

(2) With a redistribution program, a surtax is still subject to the general limitations of pricing as an implementation strategy, but it avoids the problems of income inequity.

(3) Several writers have made strong claims for the effectiveness of this technique, but since it has not been tried anywhere, it cannot be accurately evaluated at this time.

4. Evaluation of pricing techniques: See Attachment 9-A

a. In general, rising real energy prices will reduce energy consumption to some extent, but not as effectively as many economists would like to claim.

b. The time span is very important in this context, since there appears to be three different stages of consumer response to rising prices: an immediate small reduction, short-term stabilization or even return to original consumption levels, and long-term consumption declines as as energy consuming equipment is slowly replaced.

c. Pricing techniques can have severe inequitable effects on low-income people unless they are coupled with a mechanism such as an equal redistribution program or low-income energy grants that will offset the inequities of rising energy prices.

<u>C. Incentive Techniques</u>: See Suggested Reading: Cunningham, Lopreato

1. Main characteristics

a. Intention: To make it financially advantageous for people to change their energy consumption practices.

b. Theory: Rests on the "selective incentives" argument of collective action theory. Assumes that people's behavior is responsive to financial benefits or penalties.

c. Instruments:

(1) Monetary benefits and penalties

(2) Symbolic rewards and penalties

d. Techniques

(1) Inducements

(2) Deprivations

2. Inducements

a. Characteristics

(1) Giving monetary or sometimes symbolic benefits or rewards to people for taking desired actions such as reducing energy consumption to changing to renewable energy sources.

(2) Typical mechanisms for giving inducements are tax exemptions or credits, property and sales tax exemptions, rebates against purchase prices, etc. Symbolic rewards might include public recognition of energy conservation or solar energy activities, etc.

b. Effectiveness

(1) Monetary incentives must be quite high (perhaps 50% of the initial cost of conservation or renewable energy actions) before most people will respond to them.

(2) A significant proportion of the population (perhaps as large as one-fourth) is suspicious of all financial inducements (particularly interest-free loans) and will not respond to them under any conditions.

(3) Low-income people often do not pay taxes, and hence do not benefit from tax exemptions and credits, and even 50% of the initial cost may be too high for them to pay themselves.

(4) Symbolic inducements, if designed and administered in an adequate manner, can be more effective that often realized in influencing behavior.

3. Deprivations

a. Characteristics

(1) Imposing monetary or sometimes symbolic penalties on people for taking undesired actions (e.g., buying an energy inefficient car) or for not taking desired actions (e.g., failing to reduce electricity consumption).

(2) Typical mechanisms for imposing deprivations are excise taxes on purchases, energy rates that rise with increasing consumption, and fines for non-compliance with energy standards or requirements. Symbolic deprivations might include public labeling.

b. Effectiveness

(1) Some deprivation techniques require monitoring of people's activities to detect non-compliance.

(2) High-income people, who use the greatest amounts of energy, are also often able and willing to pay higher costs in order to obtain as much energy as they desire.

(3) Large proportions of the public tend to resent financial penalties, and may even rebell against such programs.

(4) Symbolic deprivations, if designed and administered carefully, can often be extremely effective in changing people's actions.

5. Evaluation of incentive techniques

a. When designed and used selectively to promote or prevent specific actions, incentives can be moderately effective in altering actions, but they must be large enough to be taken seriously by the recipients.

b. Financial incentives are most effective with middle-income people, since high-income people are not likely to be influenced by them and low-income people are often not affected by them.

c. Symbolic incentives are potentially much more influential than is commonly assumed by persons with an economic orientation toward public policy implementation.

D. Class Discussion

1. Discuss the various financial techniques, asking three questions about each one:

a. How effective can it be in reducing the consumption of energy or promoting use of energy from renewable sources?

b. How socially desirable or undesirable is it, in terms of such considerations as equity and side-effects?

c. How applicable is it to energy management at the local level?

2. If a particular financial technique is to be useful in urban energy management, it must meet all three criteria of effective, desirable, and applicable.

REFERENCES

A. Reading Assignments from Required Texts:

Energy Policy in the United States, Chaps. 6, 10

B. Suggested Readings:

Cunningham, William H. and Lopreato, Sally Cook. 1977. Energy Use and Conservation Incentives, New York: Praeger Pub., pp 76-92

Willenborg, John F. and Pitts, Robert E., "Gasoline Prices: Their Effect on Consumer Behavior and Attitudes," Journal of Marketing, Vol.41, 1977, pp 34-31.

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SESSION 10. STRATEGIES FOR MANDATORY ENERGY MANAGEMENT

Instructor Outline

A. Principles of the Mandatory Approach

1. Purpose: To change people's patterns of action by altering the physical or social settings in which they live.

2. Two forms:

   a. Regulation

   b. Design

3. Desirable features

   a. Can be implemented relatively rapidly, and are relatively easily directed and controlled.

   b. If desired, can be made equitable for all people.

   c. Can be extremely effective in changing people's actions.

4. Undesirable features

   a. Some types of mandatory programs can become very expensive for government.

   b. May restrict individual freedom of choice and action in some ways for the benefit of the entire society.

   c. Requires government to play a very active and potentially powerful role in society.

B. Regulatory Techniques

1. Main characteristics

   a. Intention: To require that energy be used more efficiently and effectively.

   b. Theory: Rests on theories of governmental regulation and social control. Assumes that most people most of the time will comply with governmental directives.

   c. Instruments

      (1) Statutory law

      (2) Administrative law

d. Techniques

(1) Energy standards

(2) Energy allocation

2. Energy standards: See Suggested Readings: McGregor and Lans

a. Characteristics

(1) Government sets required efficiency or performance standards for various types of energy use.

(2) Can take many different forms, such as building codes, mandatory retrofitting requirements, highway speed limits, and appliance efficiency standards.

b. Effectiveness

(1) Both the effectiveness and the fairness of energy standards depend largely on how they are formulated and administered.

(2) The public must feel that the standards are both necessary and fair before they will willingly comply with them.

(3) They need not limit individual freedom of choice or action in a direct or oppressive manner.

(4) They require government to practice surveillance in some manner and to apply sanctions for noncompliance.

(5) They can be a quite rapid and effective way of reducing energy consumption and promoting use of renewable energy resources.

3. Energy allocation

a. Characteristics

(1) Government specifies how fuel or energy will be distributed among categories of users, or how much energy consumers may use.

(2) Examples of this approach include state or local gasoline allocation quotas, rationing programs, and mandatory consumption reductions.

b. Effectiveness

(1) The public dislikes allocation and rationing programs, and will not willingly abide by them except in times of perceived crisis.

(2) The government must establish elaborate surveillance and control procedures to ensure compliance with these programs.

(3) The government must either tolerate energy "black markets" or allow the operation of legal "white markets."

(4) It can be extremely difficult to ensure fairness and equity for all people under such programs.

(5) These programs can be extremely effective in controlling energy use if applied in a stringent manner, but they are best reserved as a last resort for emergencies.

4. Evaluation of regulatory techniques

a. The functional effectiveness of regulatory techniques and their consequences for consumers depend heavily on their nature and implementation, with the result that they can range from extremely effective to totally ineffective, and from completely fair and equitable to grossly discriminatory.

b. Public acceptance of, and compliance with, regulatory techniques is strongly influenced by people's perceptions of both the seriousness of the problem and the adequacy of the programs.

c. Infringement of the government on society and on people's lives can be kept relatively unobtrusive and minimal, but there is always a danger that the government will use its power to directly control individuals and organizations in an oppressive manner.

C. Design Techniques

1. Main characteristics

a. Intention: To alter the physical structure of communities so that daily activities will require less energy consumption.

b. Theory: Rests on broad structural theories of change. Assumes that alterations of the physical environment will affect people's behavior patterns.

c. Instruments

(1) Master plans

(2) Zoning

(3) Development programs

d. Techniques

(1) Development

(2) Planning

2. Community development

a. Characteristics

(1) Planning and constructing new facilities that require less energy than existing facilities.

(2) Possible examples include multifamily housing to replace single-family housing, mass transit systems to replace private automobiles, district heating systems to replace separate furnaces, cogeneration to replace separate utility systems, and solid waste electrical generation plants to replace land-fills.

b. Effectiveness

(1) Many of these projects require large expenditures of funds by government, which can be a serious limitation.

(2) Many such projects also require people to alter their current lifestyles, at least in minor ways, which can lead to resistance.

(3) Most of these projects assure a moderate to substantial energy saving because of their technical nature.

(4) Existing laws, regulations, and institutional practices may create serious problems in implementing many of these projects.

3. Community planning: See Suggested Readings: Harwood.

a. Characteristics

(1) A long-term, broad-scale process of modifying patterns of land use in a community, which in turn will change people's living patterns, and hence their energy consumption.

(2) Typical examples might include renovating inner-city areas to attract people to live closer to the city center, locating businesses and other employment opportunities within walking distance of housing, dividing a community into relatively self-contained clusters that included housing, work, shopping, schools, churches, and recreation facilities.

b. Effectiveness

(1) Can eventually lead to a greater amount of energy savings and use of renewable energy sources than any other single approach.

(2) Requires long lead-times, ability to do long-range master planning, ability to implement plans, and the expenditure of large amounts of public funds.

(3) Will require extensive alterations in people's life-styles, which will likely produce strong public resistance unless the public is an active participant in the planning process from the beginning.

(4) Existing laws, regulations, and institutional practices may also create serious problems in carrying out redesign programs.

4. Evaluation of design techniques

a. Government must plan a very active role in promoting, funding, and implementing development and redesign programs, which could lead to increasing governmental control over many aspects of individual and collective activities, but which could also result in the creation of communities that were very satisfying to their residents as well as energy conserving.

b. The major barriers in implementing most such projects are not technical, but rather economic, legal, and institutional.

c. Many of these programs (especially community redesign) would go considerably beyond the goal of using energy more efficiently, leading to minor or major alterations in living patterns and lifestyles. These social changes would be resisted by some people, but welcomed by others as desired improvements in our quality of life.

<u>D. Local Government Energy Management Programs:</u> Guest Speaker(s)

1. Organization

a. Office

b. Administrative linkages

2. Programs

a. Within local government

b. Public services

c. Codes and zoning

d. Planning

REFERENCES

A. Reading Assignments from Required Texts:

Energy Policy in the United States, Chap. 7.

B. Suggested Reading:

McGregor, Gloria Shepard, Davis, California: A Pace-Setting Energy Conservation City," Environmental Comment, Urban Land Institute, July, 1977.

Lans, Ken, "Seattle Proposes Mandatory Conservation," Solar Washington, Vol.1, Jan./Feb. 1980

Harwood, C.C. 1977. Using Land to Save Energy. Cambridge: Ballinger Pub.Co., pp. 11-35.

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SESSION 1. INTRODUCTION

Student Outline

A. Overview of the Course

1. Purpose of the course
    a. Overall goal
    b. Specific objectives
2. Structure of the course
    a. Course outline and session topics
    b. Reading assignments
3. Student projects
    a. Assignment
    b. Schedule
    c. Illustrations

B. Basic Energy Concepts

1. Common energy terms and definitions
2. Energy units and conversions
3. U.S. energy consumption by type of fuel
4. U.S. energy consumption by end-use sector
5. Total energy flow in the U.S.

Attachment 1-A

URBAN ENERGY MANAGEMENT COURSE
OUTLINE FOR THE QUARTER

Session	Topic
1.	Introduction A. Overview of the course B. Basic energy concepts
2.	The Energy Problem A. History of energy use B. U.S. energy trends during 1970-1973 C. Current energy sources
3.	National Energy Policies and Programs A. Alternative energy policy perspectives B. Federal energy legislation since 1974 C. Current federal energy policy proposals
4.	State and Local Energy Programs A. Funding sources for state and local programs B. State energy programs C. Local energy programs D. Citizen participation in energy management
5.	Techniques of Energy Planning A. Energy demand forecasting B. Energy economics and pricing
6.	Techniques of Energy Conservation A. Principles of energy conservation B. Energy conservation in buildings C. Energy conservation in transportation D. Energy conservation in industry
7.	Techniques of Renewable Energy Production A. Principles of renewable energy production B. Substitute fuels C. Solar Heating D. Electricity generation
8.	Strategies for Voluntary Energy Management A. Introduction to implementation strategies B. Principles of the voluntary approach C. Information techniques D. Mobilization techniques
9.	Strategies for Financial Energy Management A. Principles of the financial approach B. Pricing techniques C. Incentive techniques
10.	Strategies for Mandatory Energy Management A. Principles of the mandatory approach B. Regulatory techniques C. Design techniques

Attachment 1-B

COMMON ENERGY TERMS

Energy - the capacity to do work. Commonly measured in units of foot-pounds, joules or kilowatt-hours.

Work - the product of force times distance. Measured in same units of energy.

Force - the pull of gravity, the push of the wind, the pull of a magnet, friction commonly measured in pounds. Forces are a common way to transfer energy from one body to another.

Power - the rate of doing work. Commonly measured in units of horsepower, kilowatts, and joules per second.

Fuel - any substance used primarily as a source of energy, e.g., gasoline, coal, gas, wood and oil.

Electricity - a form of energy associated with charged particles whose capacity to do work is commonly measured in kilowatt-hours.

Electric capacity - the designed ability of generating device to produce electricity at a given rate or power level. Commonly measured in kilowatts.

Potential energy - energy by virtue of position in a force field.

Kinetic energy - energy by viture of motion.

Thermal energy - the kinetic energy associated with the random motions of the atoms or molecules of a substance.

Nuclear energy - energy derived from the rearrangement of nucleons in a nucleus of an atom.

Fission - a nuclear rearrangement in which a large nucleus having many nucleons becomes two smaller nuclei.

Fusion - a nuclear rearrangement in which two small nuclei fuse (join) to become a single larger nucleus.

Solar energy - the energy radiated by the sun as a result of the process which occurs in the interior nuclear fusion. Used commonly to refer to all forms of energy as a result of solar radiation impinging on the earth, such as direct radiation, chemical energy stored in plants (biomass), hydropower, and wind. This energy ultimately comes from nuclear fusion of the sun.

Geothermal energy - energy contained in the earth usually referring to hot springs, heysers and other hot spots in the upper crust of the earth.

Tidal energy - energy (kinetic or potential) derivable from earth tides. This energy ultimately comes from the gravitational field of the solar system.

BTU - British Thermal Unit, a measure of energy equal to the amount of heat required to raise the temperature of one pound of water one degree fahrenheit.

Calorie - a measure of energy equal to the amount of heat required to raise the temperature of one kilogram of water one degree celcius.

Temperature - an arbitrary measure of the thermal energy contained within a unit amount of material. Two scales are in common use: fahrenheit and celcius (centigrade).

Absolute zero - the temperature at which there is no thermal energy in a substance.

Hydro power- the rate at which work is done by falling water or flowing water. Usually measured in horsepower.

Hydroelectric power - electricity generated by hydro power, generally a water driven turbine connected to a generator.

Nuclear power plant - a plant in which the fission energy is converted into heat which produces steam, which in turn is used to drive a steam turbine connected to a generator.

Indirect solar heat - heat for various purposes from the storage of sun-heated liquids, gases or solids.

Green house effect - the entrapment of solar energy because degraded solar radiation cannot pass through glass.

Photovoltaic cell - the direct conversion of solar rays to electricity without the necessity of a thermal cycle.

MHD - Magneto hydro dynamics - a process by which electricity can be generated by the high speed flow of ionized gas in a magnetic field.

Heat - the process of transferring energy from one body to another, other than through the use of,forces.

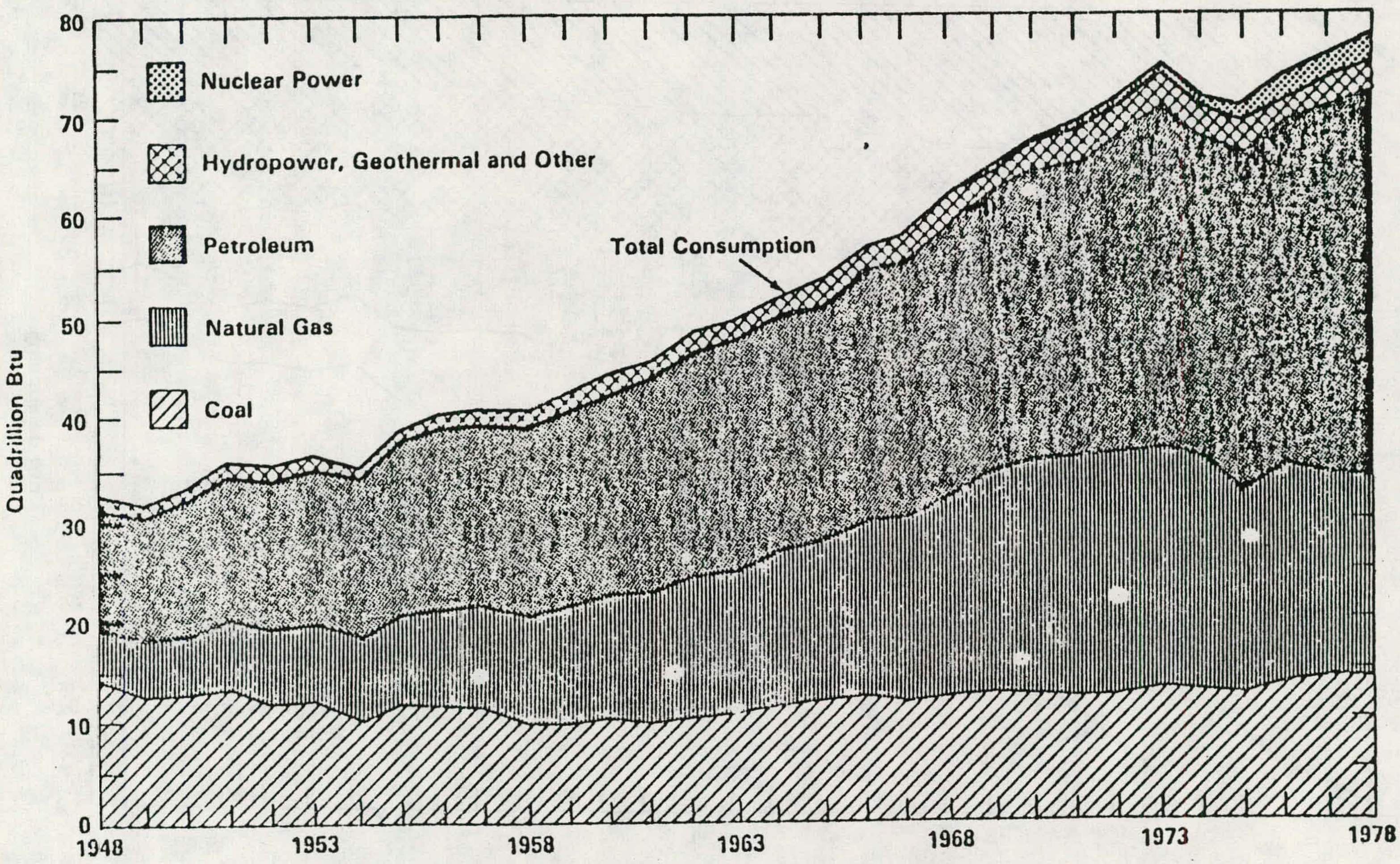
Attachment 1-C

ENERGY UNITS AND CONVERSION RATIOS

Unit		kWh	j	cal	W-yr	Btu		Coal (tons)	Oil (bbl)	Natural gas (ft^3)	U^{235} (g)	Deuterium (g)
One kilowatt-hour (kWh)	equals	1	3.60×10^{6}	8.60×10^{5}	0.114	3410		1.16×10^{-4}	5.88×10^{-4}	3.41	4.35×10^{-5}	1.51×10^{-5}
One joule (j)	equals	2.78×10^{-7}	1	0.239	3.17×10^{-8}	9.48×10^{-4}	is	3.23×10^{-11}	1.63×10^{-10}	10^{-6}	1.20×10^{-11}	4.21×10^{-12}
One calorie (cal)	equals	1.16×10^{-6}	4.18	1	1.33×10^{-5}	3.97×10^{-3}	derived	1.35×10^{-10}	6.84×10^{-10}	3.97×10^{-6}	5.82×10^{-11}	1.76×10^{-11}
One watt-year (W-yr)	equals	8.77	3.16×10^{7}	7.54×10^{6}	1	2.99×10^{4}	from	1.02×10^{-3}	5.16×10^{-3}	30	3.80×10^{-4}	1.33×10^{-11}
One British thermal unit (Btu)	equals	2.93×10^{-4}	1054	252	3.21×10^{-5}	1		3.41×10^{-8}	1.72×10^{-7}	10^{-3}	1.28×10^{-8}	4.44×10^{-9}
One metric ton of coal (=10^{6} g)	yields	8600	3.10×10^{10}	7.40×10^{9}	981	2.93×10^{7}		1	5	2.94×10^{4}	0.37	0.13
One barrel (bbl) of oil (=42 gal)	yields	1700	6.12×10^{9}	1.46×10^{9}	194	5.80×10^{6}	is	0.2	1	5800	0.07	0.026
One cubic foot (ft^3) of natural gas	yields	0.29	1.05×10^{6}	2.52×10^{5}	0.033	1000	equivalent to	3.41×10^{-5}	1.72×10^{-4}	1	1.27×10^{-5}	4.44×10^{-6}
One gram (g) of U^{235}	yields	2.30×10^{4}	8.28×10^{10}	1.98×10^{10}	2620	7.84×10^{7}		2.7	13.5	7.84×10^{4}	1	3.5
One gram (g) of deuterium	yields	6.60×10^{4}	2.38×10^{11}	5.60×10^{10}	7.53×10^{3}	2.25×10^{8}		7.7	39	2.25×10^{5}	2.9	1

Attachment 1-D

U.S. ENERGY CONSUMPTION BY TYPE OF FUEL

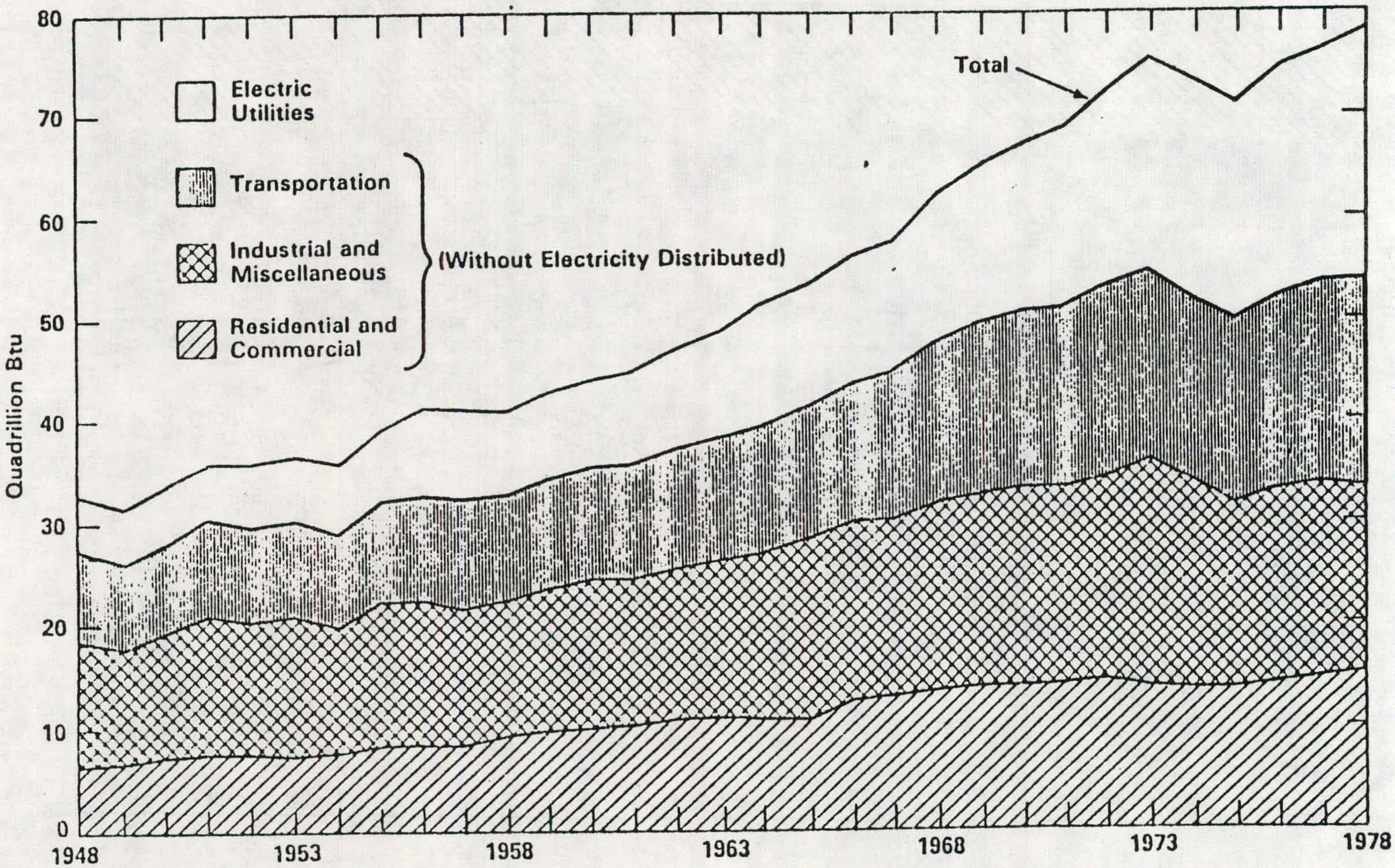


Energy consumption in the United States increased at an average annual rate of 3.3 percent from 1948 through 1973. During this period, petroleum and natural gas grew at average annual rates of 4.4 percent and 6.3 percent, respectively. During 1974 and 1975, energy consumption declined at an average annual rate of 2.6 percent.

Since 1975, total U.S. energy consumption has increased at an average annual rate of 3.3 percent. This increase was principally attributed to petroleum and coal; their average annual increases were 4.9 percent and 3.2 percent, respectively. The 1978 energy consumption of 78.01 quadrillion Btu was 1.9 percent above the 1977 level.

Attachment 1-E

U.S. ENERGY CONSUMPTION BY END-USE SECTOR

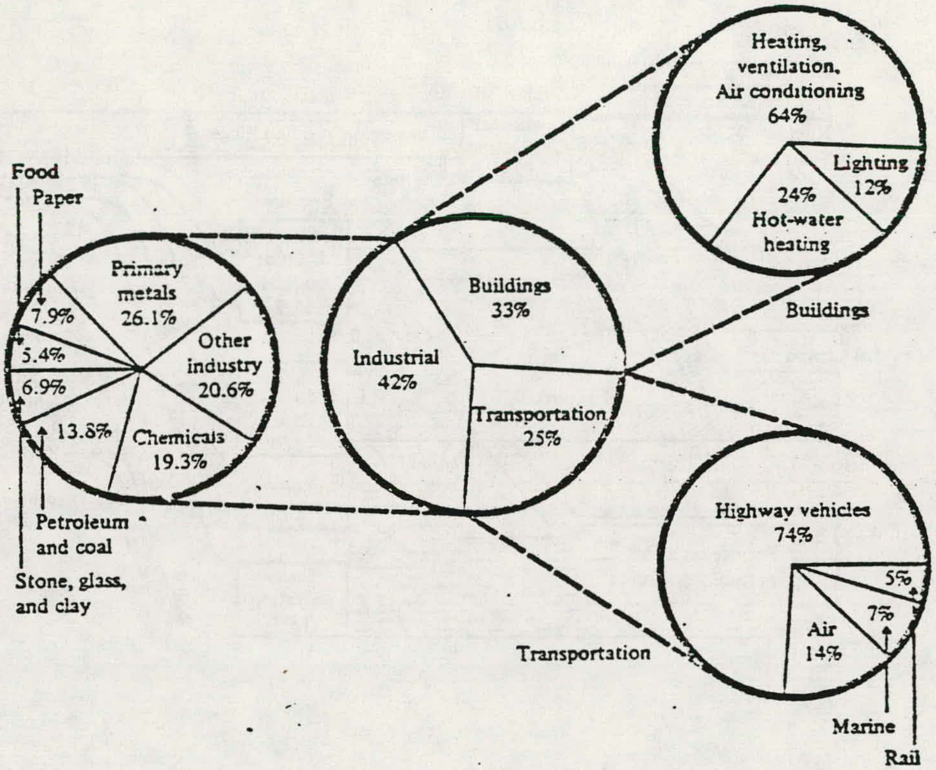


Energy consumption from 1948 through 1978 increased at an average annual rate of 2.9 percent. Without electricity distributed, the electric utility and transportation sectors experienced the most growth during this period. The average annual increases were 5.5 percent for electric utilities and 2.8 percent for the transportation sector. With electricity distributed, the residential and commercial sector from 1948 through 1978 had the largest (4.0 percent) average annual increase followed by the transportation sector, 2.8 percent, and the industrial and miscellaneous sector, 2.2 percent.

In 1978, without electricity distributed, electric utilities accounted for 30.5 percent of total energy consumption, followed by transportation, 26.3 percent, industrial and miscellaneous, 23.9 percent, and residential and commercial, 19.4 percent. In 1978, with electricity distributed, the residential and commercial sector was the largest, accounting for 37.6 percent of the total, followed by industrial and miscellaneous sector, 36.1 percent, and transportation sector, 26.4 percent.

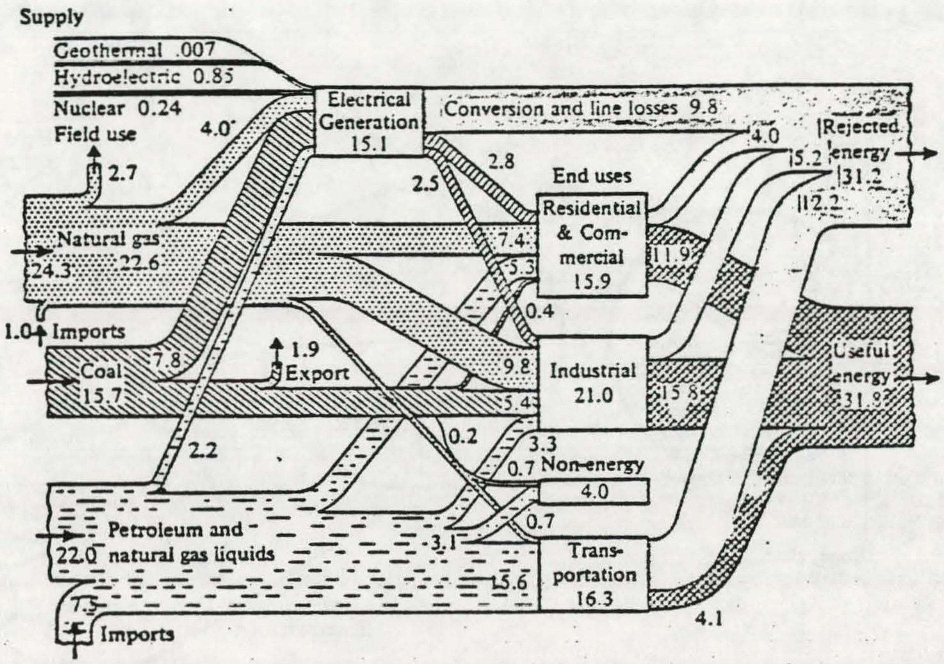
Attachment 1-F

U.S. ENERGY CONSUMPTION BY END-USE SECTOR AND SUBSECTOR



Attachment 1-G

TOTAL ENERGY FLOW IN THE U.S. (1970)*



* Units in Quadrillion BTU

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SESSION 2. THE ENERGY PROBLEM

Student Outline

A. History of Energy Use

1. Emergence of energy as a commodity
2. Theories of resource development
3. Governmental regulation of energy

B. U.S. Energy Trends During 1950-1973

1. Growth in energy consumption
2. Decline in real energy prices
3. Constant ratio of energy demand to Gross National Product

C. Current Energy Sources

1. Oil
2. Natural gas
3. Coal
4. Nuclear energy

Reading Assignment

Robert Stobaugh and Daniel Yergin, Energy Future, Chaps. 1-5

Stephen Lyons, Sun!, pp. 185-195

William Brewer, "History of Energy Use," Reference 2-A

Attachment 2-A

HISTORY OF ENERGY USE

William Brewer

Mankind's energy supply for millenia uncounted has been both "natural" and "renewable", consisting of solar and biomass. Great voyages of exploration were made with windpower (a form of solar energy) and cordwood supplied energy to early but quite adequate industrial engines (Watt, 1781); commercial rail service began in 1825 and transatlantic steamer service in 1838. Coal soon became the fuel of choice for these steam-driven "modern" technologies, but only because of a classic *energy crisis.*

Most of what we need to know in order to understand today's energy supply and price upsets can be illustrated in the shift from solar energy and its derivatives (biomass, animal, wind and water power) to a *fossil* fuel, coal. In the "civilized" and industrializing European world of the 17th century it suddenly became apparent that one could no longer simply go out into the woods to obtain energy for residential, commercial and industrial needs; someone else with the same needs was chopping wood from the other side of the forest, and right behind the wood-choppers were the farmers and merchants who made sure that the big trees would never grow again in those spots.

Wood was in demand; supply was short; yet the technology of the times was geared to wood as fuel. Also, wood fuel was benign in the *environmental* and *socio-economic impact* areas; people knew how to use it, and it was not considered hazardous to either their health or their ethical beliefs. The latter is important; through the Dark Ages, in Europe, there was a deep religious distrust of digging into Mother Earth for any purpose whatsoever, which carries over in today's conflict over energy development on Native American lands.

But a crisis is a crisis, and coal was developed as a fuel; at first for industry but, once it became easily available, in the home *market* too: England led the way in industrial development, and England created the first large-scale energy marketplaces as well. Coal became another English *commodity* in its world trade, and Newcastle became the symbol of energy abundance.

It is worthwhile at this point to consider the fact that - in today's terms - the wood v. coal energy crunch illustrated virtually all the current features we have to deal with:

1. A scarcity of *resources* which were once abundant and cheap
2. A disruption of historic *supply and demand* patterns
3. Technological *substitution* of energy forms
4. Concentration of power in a small group of *institutions*
5. Dependence on a high-quality but *finite* fuel resource
6. And yet, a *declining real cost* of energy, which permitted (Adam Smith's) "economic man" to become "industrial man", with his railroads and steamships, his increased use of high-technology products such as iron, steel and cement and his remarkably improved trade and communications; in short, his new *life style* based on energy consumption.

Coal made all these new things possible, even though there was considerable economic and technical shakeout due to this first real energy crisis. The nations that had coal and knew how to use it were the winners during the mid and late 19th century: The U.S., Germany and the British empire. Energy- and technology-poor nations like Sweden, Spain and Portugal were left in the dust, their empires and political power fatally diminished. To elaborate:

In the 1840s coal began to be developed on a large commercial scale in the U.S., and the age of "King Coal" did not peak until

1920. Coal was dirty, dangerous to mine and, in England, gave rise to the "pea -soup" fogs of London in the age of Dickens. But coal was also cheap, flexible and, once mechanical aids to mining were developed, abundant.

Importantly, it made iron, steel and concrete cheap, which spurred the development of the railroads and, in turn, further cut delivery costs. In the "gas light" era, coal and water were used to make "town gas" for urban areas, and a little later, coal-fired plants provided electricity on a commercial scale. By the time of WW I, coal derivatives spurred (in Germany) the modern chemical industry.

With all this *progress,* it was unfashionable to seek flaws in the system. And it was a pretty good system at that: coal enriched its owners, developers and merchants, but the marketplace was quite *competitive* in terms of emerging economic theory: the consumer got full measure for his money. Coal made travel by land and sea, for the first time, available to virtually anybody in the advanced nations, and allowed food, merchandise and industrial products to be sold easily in national and world markets. Coal provided industrial jobs to former farmers and sharecroppers, and to millions of immigrants to the U.S. And, most importantly, it freed the expanding, vital and energetic nations from dependence on that renewable but limited resource, firewood; once the energy supply was in hand, people dreamed big, planned big and acted big, limited only by their imagination. If there was an energy policy in the coal age, it was simply "more".

In the U.S., all this happened in a space of about fifty years.

And *free market* economic theories were totally vindicated; private enterprise did it all, with benefits to all. It was the next-to-last unqualified energy miracle.

Or was it an unqualified success? Only recently have we learned how to keep score on *system* costs in energy, and only in the past decade or two has the *resource theory* of economics taken hold in energy policy and planning. Some definitions are needed here:

Policy, for our purposes, is simply a statement of how things ought to be, without a roadmap of how to get there. Thou shalt not kill. Save energy. Planning and implementation, in the U.S., are carried out in a number of ways; much of the practical, day-to-day implementation of policy is done in *cultural and ethical* ways. Plant a Victory Garden. Turn off the lights. Pay your taxes.

And then there is the law, and regulations with the force of law. Our system recognizes three basic forms: *statutory, case and administrative* law. All three, plus the attitudinal effect, plus new theoretical and practical knowledge, contribute to our energy policies and planning. Conflicts are inherent, especially in times of transition - coal was not instantly accepted, any more than solar, conservation and the like are accepted today as replacements for the age of petroleum.

In the particular case of coal, we learned: besides accidental death and injury, silicosis and forms of emphysema, *industrial diseases* are built-in to energy industries; mining destroys surface use and productivity of the land and water, unless costly *mitigation* is undertaken and its costs *internalized* in the final energy cost; as a fossil fuel, there is no new coal being created, but economically, we mine the easiest seams first - postponing until later the sharply rising costs of going deeper in the earth and farther afield to get the rest. And even so, the coal will run out one day, so we had best consider what its *highest and best use* is in, say, the year 2500. As a resource, much of the U.S. coal is publicly-owned but under lease to private interests; what is the fair return to the real owners, ourselves? There are *secondary costs* not only to the environment and public health but also to other businesses associated with coal-burning; who pays, and can this be related to the *theory of the commons* in some rational way? Resource economics attempts to grapple with these and other big questions, in dollar terms, and quickly runs into counter arguments: coal is just a commodity like overalls, potatoes and TVs, it is worth only as much as a willing buyer pays a willing seller, and the best thing the free-enterprise system can do is to get it to market cheaply and efficiently.

This approach says that, in a free market, supply and demand will always be in balance because there is a *market-clearing price* somewhere in the system, and that any spillover costs to the environment or society at large have to be borne collectively. If the system is noncompetitive with new technology, then it will die, only to be replaced by something better and cheaper or, as in WW II Germany, dictated by polital/economic necessity.

Resource economics disputes these points, and there is now evolving in this country yet a third approach, which we might call the *societal* approach: people have basic rights as a result of being people and, as Americans, one of these is the right to cheap energy; it is not fair to deprive a poor person of heat, light, transportation and convenience simply because of inability to pay the going price; environmentalists and other theoreticians are the enemies of the poor and the marginally-employed because both the free-market and the resource principles act to raise the cost of energy to those who can least afford it.

Now this discussion began with coal in the 19th century, and with the statement that we can understand today's energy problems by looking at the historical record. In fact and historic recollections of attitudes, coal was *perceived* as a triumph of man's domination of nature; smokestacks belching black effluent were immortalized on corporate letterheads and U.S. currency; giant enterprises were founded which still employ people productively and pay regular dividends to shareholders. Among the chief beneficiaries are the *Western railroads and the Indian people*, as residual owners of the coal too expensive to mine fifty or a hundred years ago but now in resurgence - that is a later story.

What happened, in 1859, that changed the coal dominance of industry, technology and attitudes was the discovery and marketing of *petroleum*, which covers both oil and natural gas.

If coal was good, oil was great. Its availability led to the *internal combustion engine* in the 1880s; little known is that one of the first such engines ran on pulverized coal.

Another fossil fuel, petroleum is much more complex in its makeup; cleaner, safer and easier to produce than coal; and much more versatile in use. Its chemical complexity is of paramount importance; the list of useful refined or processed products is endless. And, in the early days of the industry, it was simply cheaper than coal; in the 1920s and 30s, a barrel of crude oil, with the energy content of a half-ton of coal, sold in the fields of California, Texas and Oklahoma for the price of one hour's labor by a skilled craftsman - 30 to 40 cents. Even in 1979, fully- *amortized* production costs in the Middle East for certain fields is at the same figure, even after fifty years of inflation.

But around the end of the 19th century, oil was a desirable,yet exotic commodity. A brilliant hustler, John D. Rockefeller, set a pattern of conduct and management for the oil industry which persists today and, along the way, he triggered the first *energy policy Act* in U.S. history - the 1911/1912 *Sherman Antitrust Act*.

Previously, all minerals including oil were considered equal; the U.S. mining laws fully codified in 1872 said, in effect, that if you find it on public land, it's yours. On private lands, you have make deals with the owners, but the virually free availability of minerals and petroleum on public lands establishes a ceiling on your costs of acquisition of the resource. Rockefeller's Standard Oil Company was the most successful in acquisitions, and as the markets grew, the most successful in controlling them - often by unscrupulous methods. The Antitrust Act was not aimed solely at oil or Rockefeller, but his company was its first victim; to re-establish a competitive market for oil products, Standard was broken up into several separate companies. The New Jersey company became EXXON, New York Mobil, California Chevron and so forth. In terms of policy, the thinking was to protect the consumer against artificially high prices, a theme that has continued in energy policy to this day.

Competition certainly was established, and great successes in exploration technology quickly created a national and worldwide oil glut, in the 20s and 30s. Because production costs of the "gushers" (rare but real in a few cases) were so low, the oil was squandered, at the expense of sustained production. In the mid-30s, "conservation and control" agencies were set up by the producing states, typified by the *Texas Railroad Commission*. This body set tight production limits, with the force of law, in order to keep prices at a level which would make costs plus a profit, and would eventually make more oil available from each field. As policy, these acts served to increase consumer costs; in *real dollars*, gasoline was as expensive in 1935 as it is in late 1979.

The apparent policy conflict between federal and state energy laws, and between laws in the same jurisdiction, is quite typical of this complex area. For example, natural gas was mostly a waste product from oil production until pipelines were built and markets created for it by the industry. But it soon became a fuel of choice for domestic users, and the *Federal Power Commission* stepped in to set maximum wholesale prices in *interstate commerce*, while the states' *public utility commissions* regulated retail rates. Then in 1973/74 gas became critically scarce, and the producers argued with considerable justification that it just wasn't worth going after new, costly supplies at the old prices. FPC waffled for years before granting price increases, and only now are we moving toward price decontrol.

Oil prices also received federal attention; in the 50s and 60s there was a schiziod, shifting reaction by Congress toward imported oil, sometimes favoring the lower cost supply and then moving toward protection of the domestic producers' profits. During this period oil policy was written by the Senate, in the form of actions by a few powerful committee chairmen. But Congress also took some longer-range steps: it modified federal leasing procedures to maximize government revenues for *exploration rights*, and it finally settled the claims of the states for *offshore* oil lands. Until the *1973 Arab oil embargo*, Congress moved lightly and cautiously against the status quo; the Arab embargo and the sudden power of

OPEC are now being attributed to the *international and multinational* oil companies, with possible aid from the State Department.

But two other areas began, in the late 60s and early 70s, to produce dramatic effects on energy supply; costs and availability of domestic resources (vs. foreign). Indeed we are still unable to see clearly what their outcome will be.

First, nuclear power, hailed in the post WW II period as the triumph of technology and saviour of the utilities, began to default on its promise. It worked, and still does, but at much higher cost, with longer lead times and with more, or at least more appreciated risks to health and safety, than was said in the early 60s by its ardent boosters. This setback caused many utilities to continue, and even increase their reliance on oil and gas even when it was apparent that supply and cost upsets were imminent. Thus instead of freeing oil and gas for industry, homes and transportation, the downward spiral of nuclear power's fortunes exacerbated the petroleum crises at the worst possible time.

The second blow was fallout from the environmental concern which gripped the U.S. through the 60s and culminated in the *National Environmental Policy Act of 1970*, along with associated legislation and creation of a large, powerful regulatory agency. NEPA itself is short and simple; it only says, "look before you leap". But both EPA and the state agencies patterned on it were given enormous powers through administrative law, and virtually all of them have become "hard-liners" on standards and enforcement.

Few question that, especially in the period 1950 through 1965, technology and economics combined to create intolerable growth rates of pollutants and tragic despoilation of natural ecosystems. NEPA was well-conceived and well-timed; the arguments arise in its current interpretations and an all-too-common tendency of its administrators to deal from a single, narrow stance with a broad, terribly complex set of issues related to energy production and use. For example: EPA regulations which force automobile exhaust emissions to be reduced "waste" almost as much gasoline as the amount of the shortfall in 1979 which followed events in Iran, and the crude price increases which became feasible for OPEC producers at that time amount to an apparently permanent penalty to the consumer of 12 to 15¢ per gallon. Alaskan coal, which contains only 0.2% or less sulfur, must be burned in utility powerplants which have scrubbers capable of removing 70% of all original sulfur in the coal; first, there is doubt that any technology can meet this standard, since it was designed for normal coals with 1 to 5% sulfur, and second, the utility would, under another EPA regulation, have to buy sulfur and add it to the flue gas in order for the electrostatic precipitators to be able to remove particulate pollutants. And the list goes on.

Taking the historic view, absurdities will be reduced and compromises will be reached in at least the practical matters, if not the *symbolic* ones. But in the first swing of the environmental pendulum, yet another faction with, today, excellent access to the policy-making leadership has emerged. The issue is *growth* and growth rates, as illustrated by the *Rule of 72*. Some people are fed up with the historic, expansionist, materialistic U.S. pattern and want to return to simple, non-acquisitive "lifestyles" which, among other virtues, require less energy supply per person, or even per unit of output. As with any heterogeneous grouping there are exceptions, but in general these educated, articulate people urge: "no nukes", think small in housing and transportation, abandon most chemical or non-organic products, develop solar power and alternative energy sources at a decentralized level, become self-sufficient on the land and attempt to encourage a *postindustrial society*.

The policy conflict with conventional economic systems of the U.S. is apparent and does not require elaboration; less apparent is the latent conflict at the social and societal level with the poor, old or otherwise marginally-included members of society. Nowhere is this more urgently in need of resolution than in the urban environment; urban people who are barely hanging on cannot afford composting toilets from Sweden or solar greenhouses built of aluminum, plastic sheeting and styrofoam. They can't buy 20 acres of cropland in the country; nor can they comprehend the meaning and content of a technical bulletin on agriculture, conservation or consumer economics.

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Summary

Energy policy in the U.S. today is largely petroleum policy, and we have never been able to produce coherence and stability in our stand on oil and gas. Coal, nuclear and "alternative" energy forms are all practical, but more costly, or more difficult, or more damaging, or simply messier to deal with.

Government tries to help, but is inept and conflictive at the working level, when the problem is interpretation of vague policy.

Institutions are important in determining who will get what form of energy at what price; a capitalist, free-enterprise system lodges power in some institutions while short-changing others, even though it is the only system which has proven capable of delivering the goods.

Energy crises are not new, and will recur. The historic evidence suggests that technology will find a way out, although the fossil fuels will be ever-more-costly because there are better uses for them than heating bathwater.

In urban energy management, staff and elected officials must begin to see their day-to-day energy problems, which originate at the consumer/constituent level, as repercussions of historic, national and worldwide events totally beyond their control. It is unfortunate but provable that there is very little the local government can do except apply tourniquets to bleeding wounds; federal and state/regional programs which are based in realistic appraisal are still just over the horizon.

But now that energy is being priced realistically, people may once again appreciate its value, and this means, to the urban manager, that good ideas will be listened to.

Conservation is the best idea, not because it solves the supply/ /demand problem but because it reduces the peaks of demand which, under the regulatory system, require a supplier to build and buy to the level which meets any demand foreseeable. Peaking "capacity" was easy in the old days, but is terribly costly to everybody in 1979 and future years.

If energy suppliers are to meet peak and average demands, there has to be a leveling-out process at work on the demand side. Here, local government can do a lot. Extremist regulation such as that recently enacted by Portland, OR, is interesting to contemplate and observe, but it runs counter to the way things are in big cities.

The owners and suppliers of energy are in good shape; so, also, are their ideaological opponents, the "no-growth" and extreme environmentalists. This paradox results in rising consumer costs for energy to everybody, but only the fairly affluent can ignore them. The urban middle class and the disadvantaged will suffer in an inverse ratio to their disposable incomes, but in terms of real dollars, their suffering will be no greater than what they are experiencing in food, housing and other costs of living.

Energy has, since the rise of coal, become a commodity in national and world markets, and it is probably unwise to treat it as a special case in social theory. While beyond the scope of this lecture, it is true that there are certain limits and leveling forces at work, such as synthetic fuel products from shale or coal, and photovoltaic electricity supply. The joyride of constantly- declining real costs is ended, but the upper limits have been established for the next century or two.

Energy use in an urban community will be determined not so much by the community's "policy" declarations as it will by population and commercial/industrial use patterns. Careful, knowledgeable legislation can,coupled with awareness of forthcoming technological advances,act to reduce, but not cure, the community's energy problems. While technology may set the upper limits, the lower limits will be set by economic considerations for as long as the classic economic theories persist in this country.

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SESSION 3. NATIONAL ENERGY POLICIES AND PROGRAMS

Student Outline

A. Alternative Energy Policy Perspectives

1. Four different perspectives

    a. High technology

    b. Energy efficiency

    c. Appropriate technology

    d. Societal transformation

2. Amory Lovins' two energy paths

    a. The hard energy path

    b. The soft energy path

    c. Transition technologies and policies

B. Federal Energy Legislation Since 1974

1. Major legislation between 1974-1977

    a. Solar Energy Research and Demonstration Act

    b. Energy Policy and Conservation Act

    c. Energy Conservation and Production Act

    d. Electric Vehicle Research, Development, and Demonstration Act

    e. National Energy Extension Service Act

2. The National Energy Act of 1978

    a. Public Utilities Regulatory Policies Act

    b. Energy Tax Act

    c. National Energy Conservation Policy Act

    d. Power Plant and Industrial Fuel Use Act

    e. National Gas Policy Act

3. Energy Legislation of 1979

   a. Department of Energy Standby Conservation Plan 2

   b. Emergency Energy Conservation Act

   c. Energy Management Partnership Act

   d. Community Energy Efficiency Act and Local Energy Management Act

   e. Priority Energy Project Act

   f. Crude Oil Windfall Profit Tax Act

C. Durrent Federal Energy Policy Proposals

   1. Discuss recent proposals

Reading Assignment

John Sawhill, Energy Conservation and Public Policy, Chaps. 1, 3

Stephen Lyons, Sun!, pp. 9-67

Barry Hyman, "Alternative Energy Policy Perspectives," Reference 3-A

U.S. Department of Energy, A New Start: The National Energy Act , 3-B

Suggested Reading:

Lovins, Amory, 1977. Soft Energy Paths: Toward a Durable Peace. Cambridge: Ballinger, pp. 25-60

Attachment 3-A

ALTERNATIVE ENERGY POLICY PERSPECTIVES

Explanation: Underlying all the technical and economic debate over solutions to the energy problem is a more fundamental ideological controversy about the kind of society we want to have in the future. The true nature of the technological/economic debate cannot be appreciated without an understanding of this underlying socio-cultural conflict. Four alternative ideological perspectives on the energy problem can be identified:

High technology, or the "historical growth" scenario. The ultimate solution to the energy problem lies in new, extremely complex, and highly centralized technology. Primarily this will be breeder reactors and synfuels, although it may eventually include nuclear fusion solar electricity generating stations. Other technologies, such as conservation and solar, are at most only transition techniques to get us through the next 20 or 30 years until high technology can permanently solve the energy problem. The goal of this approach is to permit continued economic and energy growth, with consequent improvement in our standard of living.

Energy efficiency, or the "technical fix" scenario. With this approach, the ultimate solution to the energy problem still lies in new technology. It gives much more serious attention, however, to producing and consuming energy as efficiently as possible. Energy conservation through greater operating efficiency is viewed as a major source of energy that can solve much, if not all, of the energy problem. This perspective wants to maintain or improve our standard of living, but asserts that this can be attained with only moderate or no energy growth.

Appropriate technology, or the "conservation/solar" scenario. The solution to the energy problem, from this perspective, lies in extensive energy conservation combined with increasing use of energy from renewable (solar) sources. It advocates using a diverse array of energy technologies, all appropriately scales to the task at hand, and all relatively decentralized. Some minor lifestyle changes will be necessary to achieve these goals, but they will not create serious problems. Its goal is to reduce our total energy consumption by 30% to 40% percent, and produce most of that energy with appropriate solar techniques.

Societal transformation, or the "small is beautiful" scenario. This perspective incorporates extensive energy conservation and a total shift to renewable resources, and also calls for new lifestyles and social institutions that are less oriented toward energy consumption. The basic goal of this approach is to improve our quality of life in a non-material sense. It particularly stresses developing new patterns of "simpler living" that will enrich individual lives and social relationships. As a result, the U.S. would become a truly "post-industrial society."

Attachment 3-B

A NEW START
THE NATIONAL ENERGY ACT

U.S. Department of Energy

Attachment 3-B

A New Start

"Today we can rightfully claim that we have a conscious national policy for dealing with the energy problems of the present and also to help us deal with them in the future."

Those were the words of President Carter at the signing on November 9, 1978, of the most comprehensive energy legislation the Nation has yet enacted.

The National Energy Act is a significant first step toward assuring the adequacy of domestic energy supplies and the health and vitality of our economy.

As President Carter said after passage of the Act, "We have declared to ourselves and to the world our intent to control our use of energy, and thereby to control our own destiny as a Nation."

Underscoring its importance are estimates indicating that full implementation will save the Nation at least 2.5 to 3 million barrels of oil imports a day by 1985 over what otherwise would be the case. And for each million barrels of oil per day not imported, the United States saves at least $5 billion a year in overseas payments.

Energy Secretary James R. Schlesinger, whose department is administering the Act, said its purpose "is to put into place a policy framework for decreasing oil imports by:

- replacing oil and gas with abundant domestic fuels in industry and electric utilities, such as coal,
- reducing energy demand through improved efficiency,
- increasing production of conventional sources of domestic energy through more rational pricing policies, and
- building a base for the development of solar and renewable energy sources."

When President Carter submitted to Congress the Plan on which the National Energy Act is based, he said, "There is an energy challenge to be met . . . . I have faith that meeting this challenge will make our lives more satisfying. We can rediscover the ingenuity and the efficiency which have made our Nation prosper, rather than deepening our dependence on insecure imports and increasingly expensive conventional energy supplies."

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THE CHALLENGE

The President mentioned "meeting a challenge." What challenge? Isn't there plenty of energy, plenty of oil? We read about "oil gluts," and about "significant new oil discoveries." Why is there a challenge?

There is indeed an energy challenge to be met, a transition to undergo, an oil problem to be solved. Last year, this country used energy at a rate equivalent to 37 million barrels of oil a day. Almost *half* of that energy came from oil itself. And almost half of that oil, *a quarter of our total energy consumption*, was imported. Each and every hour, the United States imports an average of almost 400,000 barrels of oil, an unsustainable rate.

THE REALITIES

The National Energy Act is based on recognition of four realities:

1. World oil production will peak sometime during the next 15 years, while world oil demand will continue to grow. Exactly when this prospective supply-demand gap will occur depends on the willingness and ability of the Organization of Petroleum Exporting Countries (OPEC) to produce, and on the willingness and ability of the United States and other nations to limit demand. This gap is expected to occur in the mid- to late 1980s, but could occur sooner.
2. Even if adequate oil supplies were available in the mid- to late 1980s, the United States could not afford to pay for them. The balance of payments outflow would have fiscal and economic effects that would be increasingly unacceptable, socially and politically, domestically and internationally.
3. Even if these economic, political, and social impacts could somehow be minimized, foreign policy and strategic and national security implications of increased oil import dependency would be intolerable.
4. The world oil problem *will* be resolved, either *uncontrollably,* through severe economic shocks to national economies, or *controllably,* through concerted early action to ease the transition that must be made to more abundant sources.

So we have no alternative; we *must* reduce dependence on the oil we're importing, and we must use the oil we consume more efficiently. To achieve this goal, the President asked for, and Congress gave him, with some modifications, energy legislation covering the following areas:

Energy Conservation
Coal Conversion
Utility Rate Reform
Natural Gas Pricing
Tax Credits for Energy-Saving Investments

Brief descriptions of each of these portions of the Act are given below.

CONSERVATION: Highlights of the *National Energy Conservation Act of 1978*

The reduction of energy demand through efficiency is central to the objectives of the National Energy Act. Conservation provides each member of the public, every family and business and industry, a chance to take direct action to reduce their own energy bills and, consequently, the amount of dollars spent overseas to pay for imported oil.

Benjamin Franklin once said, "A penny saved is a penny earned." Today, it can be said that: "A barrel of oil saved is a barrel of oil earned, and then some." It may cost a little to save a barrel of oil, for example, by insulating your home. It may cost nothing at all, for example, by turning out unneeded lights. The average cost of conserving a barrel of oil is estimated at less than $7 a barrel. But to *buy* that barrel of oil from overseas would cost $14 or $15 now, and $16 or more by the end of 1979. Synthetic oil made from coal might cost the equivalent of $25 a barrel, or more.

So in a very real sense, conservation is our *best, cheapest,* and *quickest* source of oil supply. In fact, our wasteful and inefficient use of energy in the past gives us broad opportunities to conserve. "We must," Secretary Schlesinger said, "avoid increased dependence on oil .... We must achieve a higher degree of fuel efficiency. We must learn to conserve."

A major conservation provision requires governors to submit plans to the Secretary of Energy on how electric and gas utilities and oil dealers in their states will advise customers of conservation and solar energy measures and the savings and costs of such measures. The Act requires utilities to inspect on request a customer residence. Lists of lenders, suppliers, and contractors must be provided along with offers to arrange for installation and financing of conservation and solar materials by listed firms. Except in certain cases, utilities are prohibited from actually installing materials or making loans.

Other provisions that encourage conservation include the following:

- Grants of up to $800 for low-income urban families for insulating or weatherizing their homes.
- Grants of up to $1500 for weatherizing homes of low-income rural families through the Farmers Home Administration.
- Grants through HUD to finance energy conservation improvements for multi-family housing projects for the elderly, handicapped, and low- or moderate-income families. The Act requires HUD to set minimum energy efficiency standards for multi-family houses and for new FHA housing.
- Loans and loan insurance for residential energy-saving improvements, and for the installation of either active or passive solar equipment.
- A 20 percent increase in federal mortgage insurance for buildings with solar heating systems.
- A 3-year $100 million program for installing solar heating and cooling in federal buildings.
- A 3-year $900 million program for energy audits and improvements in schools, health care facilities, and other public buildings.
- Energy efficiency standards for major home appliances, such as refrigerators and air conditioners.

COAL CONVERSION: Highlights of the *Power Plant and Industrial Fuel Use Act of 1978*

This country is blessed with the richest coal reserve in the Western World. A basic thrust of the National Energy Act is to reduce our dependence on imported oil by at once expanding domestic

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coal production, and by encouraging large users to shift away from oil and gas to coal, waste, and other fuels, used in environmentally acceptable ways.

The National Energy Act will help achieve this shift by:

- Prohibiting the use of oil or natural gas in new utility generation facilities, or in new industrial boilers with fuel-heat input rates of 100 million Btu's per hour or more.
- Requiring existing coal-capable facilities to use coal, and requiring other units to use coal-oil mixtures.
- Requiring the use of natural gas in industrial and utility plants to end by 1990 (with certain exceptions) and limiting gas use in such plants unless short-term supplies are sufficient to justify temporary exemptions.
- Helping utilities fund pollution control through an $800 million loan program.
- Prohibiting use of natural gas in small boilers (less than 100 million Btu's per hour) for space heating and for decorative lighting.
- Funding several programs to reduce the social and environmental effects of increased coal production.

UTILITY RATES: Highlights of the *Public Utilities Regulatory Policy Act*

For decades, consumers were encouraged to use more, rather than less, electricity. The public utilities rate reform section of the National Energy Act, however, is based on the principle that electric rates should encourage the conservation of energy and the efficient use of resources.

This legislation requires state utility commissions to consider, within 2 years, six kinds of utility rate reforms:

1. Time of Day Pricing—charging more for electricity used during the day, when everyone is using it, and less at night.
2. Seasonal Rates—charging more when air conditioning loads are high.
3. Cost of Service Pricing—charging less for customers whose type of electric service is easy to supply.
4. Interruptible Rates for customers willing to have service cut

during high demand, and Load Management Techniques aimed at reducing demand.
5. Prohibition of decreasing rates for larger blocks of electricity.
6. Lifeline Rates—uniform lower rates for the first several hundred kilowatt-hours for residential users.

The Act does not provide the Department of Energy with the authority to force state commissions to adopt any rate reforms; it merely requires that hearings be held. Under the Act, rules changes must also be considered regarding master metering; this is the practice of having one central meter for a number of apartments, so that residents have no means of judging their individual energy consumption. Hearings must also be held to consider prohibiting utilities from advertising at ratepayers' expense.

To stimulate *cogeneration*, which is the use of excess heat produced by one process (such as electric generation) for another purpose (such as heating buildings), regulations will be developed requiring utilities to buy and sell power at fair rates from qualified cogenerators and small power producers.

The Energy Act also authorizes funds to help consumers present their cases and objections before utility regulatory commissions. An Office of Public Participation will be established within the Federal Energy Regulatory Commission (FERC) to coordinate aid to the public and to administer intervener funding assistance.

NATURAL GAS PRICING: Highlights of the *Natural Gas Policy Act of 1978*

This law for the first time creates a single national market for natural gas, which is the cleanest burning, least polluting, and most easily transported of all our fossil fuels. Previously regulations applied only to gas sold outside a producing state in interstate pipelines. Thus 40 percent of the natural gas produced has been out of the reach of the interstate market, partly because of the higher prices available inside the producing state; now all states have access to this gas.

Under our prior regulatory regime, as intrastate markets became saturated, a glut developed inside the producing states, which led to an excess of approximately a trillion cubic feet of gas production annually. That gas will now be available to flow across the country into the interstate market. As a result, consumers will benefit from more abundant supplies.

Initial price increases will be applied to large industries using natural gas as boiler fuel. Increases in gas prices for homes, schools, and hospitals will be smaller. For home heating, natural gas will remain the cheapest form of energy for many years. With more gas flowing in the interstate market, gas hookups for some existing homes and for new housing can be permitted, reducing the home heating load on imported oil.

The law provides for an end to price controls on new natural gas in 1985. At that time, after a moderate period, either the President or the Congress will have the authority to reimpose controls for up to 18 months.

The purpose of the Natural Gas Policy Act is to help reduce our dependence on imported oil in two ways:

- It will stimulate production by giving producers increased prices, so they can afford to explore more aggressively for new gas.
- It will help accelerate the switch away from gas to more abundant fuels for the most inefficient users, while making more gas available for other industrial users, as well as for new homes.

ENERGY TAXES: Highlights of the *Energy Tax Act of 1978*

In addition to the conservation measures mentioned earlier, the Energy Tax Act includes these conservation provisions:

- A tax credit of up to $300 for homeowners who install insulation, storm doors and windows, caulking, weatherstripping, modified flue openings, automatic furnace ignition systems, clock thermostats, and other energy-saving devices. This credit is retroactive to April 20, 1977, the date the President's energy message went to the Congress.
- A tax credit of up to $2200 for homeowners who install solar, wind, or geothermal energy equipment, also retroactive to April 20, 1977.

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- An extra 10 percent tax credit (in addition to the regular 10 percent investment credit) for businesses that install certain energy-saving or energy-producing equipment. This credit is retroactive to October 1, 1978.
- A tax on "Gas Guzzlers," beginning with the 1980 models. In 1980, cars getting fewer than 15 miles per gallon will be required to pay taxes ranging from $200 (for cars getting 14 to 15 miles per gallon) to $550 (for cars getting less than 13 miles per gallon). In 1985, the Gas Guzzler tax will range from $500 (for cars getting 21.5 to 22.5 miles per gallon) to $3850 (for cars getting less than 12.5 miles per gallon).

CONCLUSION

The National Energy Act is an important start toward confronting the serious energy problem that faces the Nation—indeed, faces *all* oil-consuming nations—namely, the growing dependence on insecure and finite sources of oil. We must begin now to make the transition toward more abundant, more secure fuels. We must adjust our homes, factories, and automobiles to meet these energy realities, while there is still time.

The basic problem is simple. Growth in world oil production cannot keep pace indefinitely with oil demand, which is rising relentlessly year after year. This growing appetite for oil is rapidly approaching the world's capacity to produce it, if that capacity has not peaked already. Even with a lower growth rate, the world would require production of 350 billion barrels between now and 1990, almost as much as the 360 billion barrels that have been produced since the beginning of the oil age in the mid-nineteenth century.

To be sure, finding new oil would put off the day of reckoning—the time when world oil production peaks and begins its long slide downward. But big new oil strikes have not been keeping pace with the world's need to replenish reserves. To maintain even today's pace, new fields the size of Kuwait and Iran will have to be discovered every 3 years, new fields the size of Texas or Alaska every 6 months. The last major United States oil strike was in Alaska a decade ago.

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The new National Energy Act is a good beginning toward achieving energy objectives between now and 1985. But much more needs to be done. Government action alone is not the answer. The hard work and cooperation of the American people in their homes, cars, businesses, and industries also is needed. Solving the energy problem, transforming our economy into one less dependent on imported oil, is largely up to each citizen.

Meanwhile, the Department of Energy, in consultation with the public and with Congress, is seeking new ways to reduce energy vulnerability. The department is accelerating its programs to provide alternative energy sources that could be commercially ready when conventional sources become scarce and expensive early in the next century. For example:

- Research and development programs are being accelerated to improve the efficiency of oil and gas combustion.
- Support for major experiments in magnetic confinement, laser, and particle beam fusion is being increased.
- The Federal Government's proposed solar energy budget for fiscal year 1980 approaches a billion dollars, which is a tenfold increase in solar expenditures since the early seventies.

Traditionally, the Federal Government has mainly been involved in the research and development of new technologies, leaving commercialization up to the natural processes of the marketplace. Now, however, faced with growing dependence on imported oil and what it is doing to our economy, this country does not have the luxury of waiting for the leisurely market processes to work.

So DOE is pushing toward the commercialization of those technologies that can help now, and in the near future. Some of these technologies are:

- Enhanced oil and gas recovery.
- Industrial fluidized-bed combustion.
- Passive solar.
- Solar hot water and industrial process heat.
- Low-head hydroelectric.
- Wood combustion.
- High efficiency motors.

That then is a brief appraisal of the energy challenge and a look at what is being done to meet that challenge.

President Carter said at the White House signing of the National Energy Act, "With this legislation we face the continuing challenge of the future with new tools and also with new resolve."

ADDITIONAL INFORMATION

General Inquiries	Office of Public Affairs U.S. Department of Energy Washington, DC 20585 (202) 252-5806

Specific National Energy Act Programs

Questions about . . .	**Contact**
Natural Gas Regulations	Office of Public Information Federal Energy Regulatory Commission Washington, DC 20426 (202) 275-4006
Solar and Conservation Tax Credits	Contact your local Internal Revenue Service office
Utility Rate Reform	Office of Public Information Federal Energy Regulatory Commission Washington, DC 20426 (202) 275-4006
	Office of Public Information Economic Regulatory Administration Washington, DC 20461 (202) 634-2170
Conversion to Coal	Office of Public Information Economic Regulatory Administration Washington, DC 20461 (202) 634-2170

Attachment 3-B

Weatherization of Low-Income Housing	Office of Buildings and Community Systems U.S. Department of Energy Washington, DC 20545 (202) 376-4646
Solar (Including Tax Credits)	Solar Heating and Cooling Information Center P.O. Box 1607 Rockville, MD 20850 (800) 523-2929 or (800) 462-4983 in PA (toll free numbers)
Utility Energy Audits	Office of Buildings and Community Systems U.S. Department of Energy Washington, DC 20545 (202) 376-4646
Government Assisted Loans for Conservation and Solar Energy	Government National Mortgage Association U.S. Department of Housing and Urban Development Room 6204 Washington, DC 20410 (202) 755-5593
Energy Conservation Standards for Housing	Division of Energy Building Technology and Standards Department of Housing and Urban Development Room 8148 Washington, DC 20410 (202) 755-6443

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SESSION 4. STATE AND LOCAL ENERGY PROGRAMS

Student Outline

A. Funding sources for state and local programs

1. Federal government funding programs
2. Pending new programs
3. Unsolicited proposals to government agencies

B. State energy programs

1. Energy management in (state in which the course is given)
    a. State energy situation
    b. State energy office
    c. State energy policy and programs
2. California Energy Resources Conservation and Development Commission
    a. Commission structure and responsibilities
    b. Policies and programs

C. Local (city and county) energy programs

1. Seattle, Washington, energy management activities
2. Davis, California, energy management activities
3. Energy management activities in (city in which the course is given)
4. Policy making in local government
    a. The pluralistic character of the American political process
    b. The relationship of pluralism to incremental development
    c. Applicability of pluralism to local government
    d. Applicability of pluralism to incremental decision making in research and development
    e. Applicability of pluralism to national energy policy formation

D. Citizen participation in energy management

1. General principles of citizen participation

    a. Influence of citizen participation on government

    b. Types of citizen intervention

2. Citizen participation and energy policy

    a. Importance

    b. Reasons

3. Case study: Seattle City Light Energy 1990 Report

    a. Background

    b. The process

    c. Evaluation

Reading Assignments

John Sawhill, Energy Conservation and Public Policy, Chap. 11

Stephen Lyons, Sun!, pp. 287-294

Seymour Warkov, Energy Policy in the United States, Chaps. 1, 14

Suggested Readings:

Freeman, David S. 1974, Energy: the New Era. New York: Random House, pp. 158-176

Washnis, George J. "Community Involvement. . . Why?" Public Management, December 1975.

Attachment 4-A

FUNDING SOURCES FOR ENERGY RELATED PROJECTS FOR STATE AND LOCAL GOVERNMENT AGENCIES, ORGANIZATIONS, BUSINESS, AND INDIVIDUALS

Below are listed some examples of funds available for energy related projects.

Further information may be obtained from appropriate Federal, State or local government offices, from private foundations and from catalogues of energy assistance which can be found in federal and public libraries. Examples of catalogues available are the Catalogue of Federal Domestic Assistance, published yearly, and the Annual Register of Grant Support, which lists private grant sources.

Department of Energy (DOE) Appropriate Technology Small Grant Program (Region X)
- Supports projects performed in the states of Alaska, Idaho, Oregon and Washington
- Grant funds are available for:
  - Concept Development Studies; ($10,000 maximum award per applicant)
  - Development Projects ($50,000 maximum award per applicant)
  - Demonstration Projects ($50,000 maximum award per applicant)
- Between $1 - 2 Million will be available in Region X in 1980.

Department of Energy (DOE) State Energy Conservation Program
- To establish procedures and guidelines for the development and implementation of specific State energy conservation programs
- Grants are to be used by States in the development, implementation or modification of a State energy conservation plan submitted to and approved by DOE.
- Grants FY 79 $47,000,000.

DOE Teacher Development Projects in Energy
- To train or to update the training of college and university fauclty, high school, junior high and elementary teachers in energy resource alternatives, conservation, environmental effects, and social/political aspects of energy development.
- Teacher Development Obligations FY 79 $1,300,000.

DOE Weatherization Assistance Program for Low-Income Persons
- To insulate the dwellings of low-income persons, particularly the elderly and handicapped low income.
- Grants FY 79 est $198,750,000.

HUD Community Development Block Grant Program
- Federal grants are given to local governments for development projects chosed by the communities themselves

  Also
- HUD Section 312 loan assistance can be used by individuals for weatherization projects (3% interest, 20 year repayment)

HUD Passive Solar Residential Design Competition and Demonstration
- Passive Solar Residential Design Competition and Demonstration
- $1.4 million: Awards of $5,000 each were made for 145 designs for new homes, with awards of $2,000 each for 17 retrofit designs. 80 Construction awards were given.

IRS Energy Credits for Individuals
- Expenditures for home energy conservation; and
- Expenditures for renewable energy source property

Solar Energy Research Institute (SERI)
- Accepts proposals from organizations, including small businesses, for investigation of innovative concepts for photovoltaic conversion and other solar applications.
- 1979 funding level approximately $1.5 million (to 16 organizations)

Community Services Administration National Center for Appropriate Technology (NCAT) (Butte, Montana
- provides funds for Community Development Corporations, Community Action Agencies and the State Office of Economic Opportunity.

Ford Foundation Resources and the Environment Program
- Grants for the improvement of people's environment, including support of ecological approaches in the education of resource planners and administrators; support of policy studies; and international cooperation.
- Eligibility: Qualified institutions, individuals and communities with appropriate interests.
- Grant amounts vary: Total 1978 $9,939,366 (70 grants)

Other grant programs include:

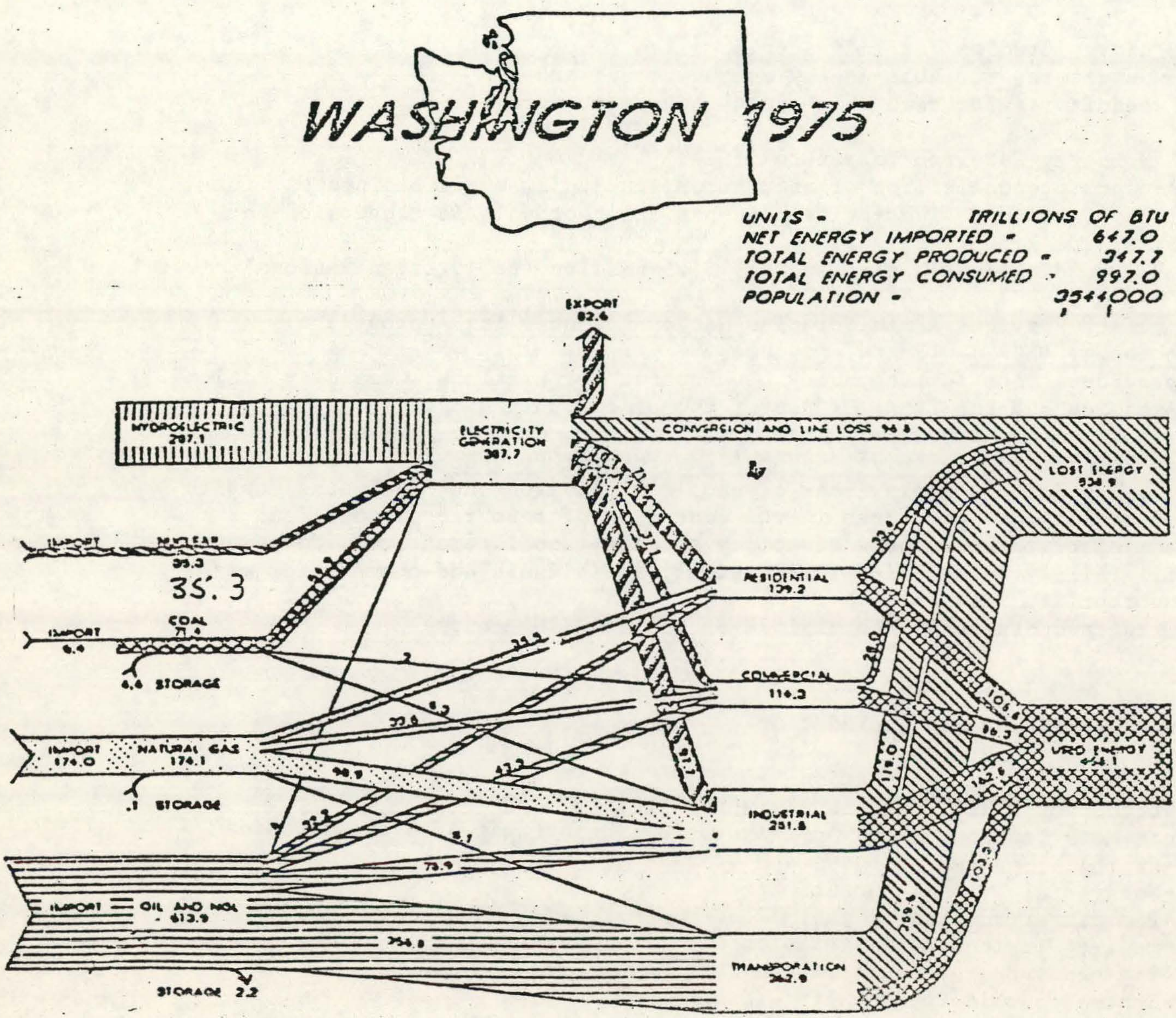
Small Business Administration
- Loans for Small Business energy projects.

Urban Mass Transportation Administration, Department of Transportation
- Capital Improvement Loans and Grants
- Managerial Training Grants
- Demonstration Grants, itc.

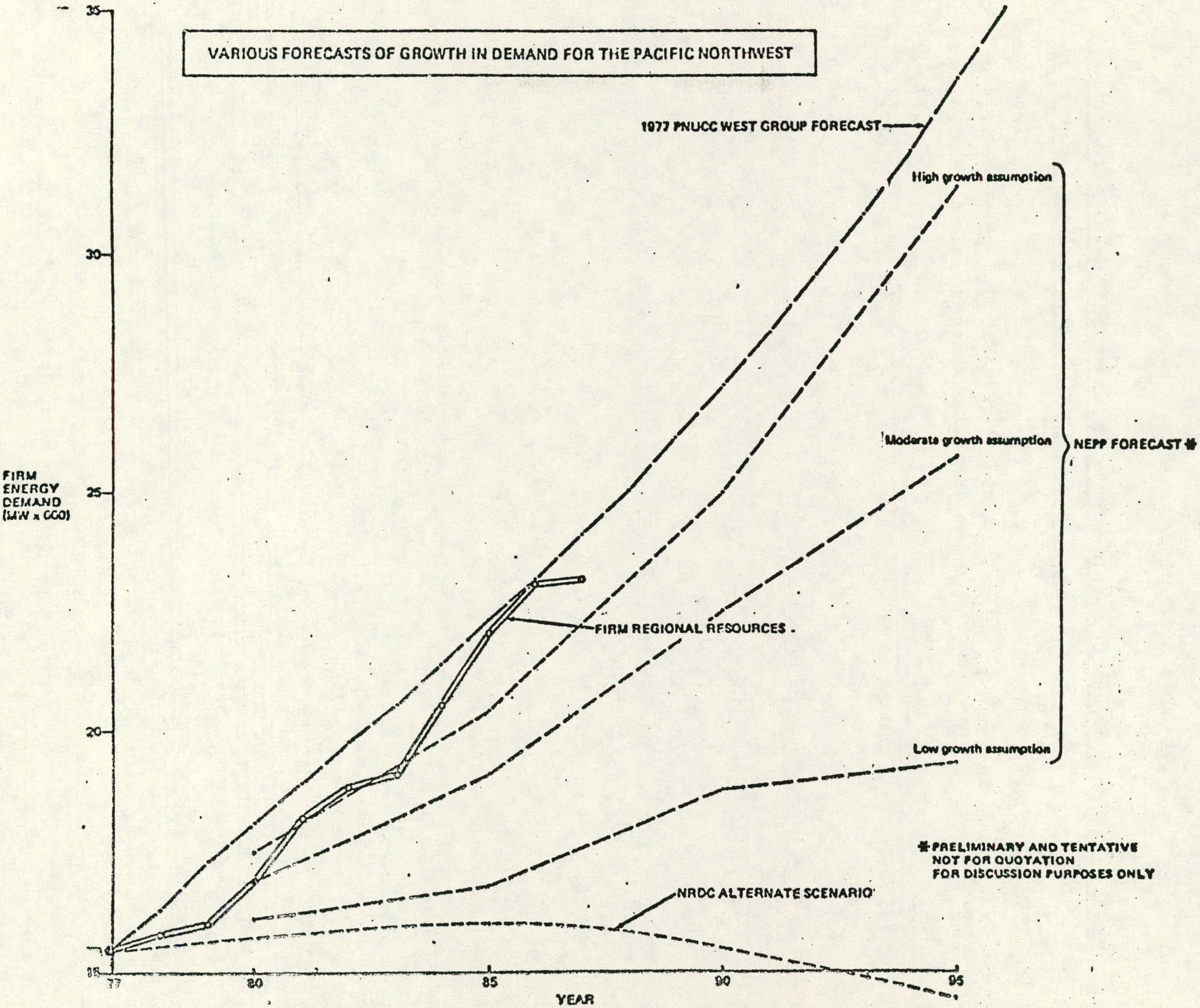
Community Services Administration
- Emergency Energy Conservation Ptrgram
- State Economic Opportunity Offices
- Community Eceonomic Development

DOE
- Energy Extension Service
- Information Services
- Work Experience
- Research and Development in Energy Conservation
- National Energy Information Center
- Grants for Offices of Consumer Services

Attachment 4-B



LOS ALAMOS SCIENTIFIC LABORATORY



Attachment 4-C

Attachment 4-D

PREDICTED FUTURE ELECTRICITY RATES IN WASHINGTON STATE

(Assumes 5% dependence on nuclear energy.)

Year	Mills per kilowatt hour in constant 1975 dollars.			
	Costs	Residential	Commercial	Industrial
1975	2.39	12.14	12.91	3.63
1980	4.51	14.13	15.07	5.79
1985	6.19	15.98	16.75	7.47
1990	10.46	20.25	21.02	11.74
1995	11.88	21.67	22.44	13.16
2000	13.90	23.08	23.85	14.57

Attachment 4-E

PROGRAM MEASURES OF THE WASHINGTON STATE ENERGY OFFICE

Program Measure	Total Cost 1978-1980	Expected Energy Savings in 1980 (1000 Btu's)	$ Cost per 1000 Btu's Saved
Thermal Standards Lighting Standards	83,949	4.30 1.20	15,263
Procurement Practices	103,912	.94	110,545
Promotion of the Availability and Use of Carpools, Vanpools and Public Transportation	57,824	.72	80,311
Residential Energy Audit Program	89,483	4.75	18,839
Homeowner's Energy Conservation Workshops	77,160	4.60	16 774
Retrofit Information Dissemination	103,589	1.38	75,064
Energy Efficient Home Promotion	7,824	.40	19,560
Driver's Education Energy Conservation Module	59,324	.65	91,268
Transportation Management and Coordination Program	61,650	6.14	10,041
Enforce 55 MPH	0	.66	N/C
Public Awareness in Transportation	63,650	.61	104,344
State Ride Share	7,214	.006	1,202,333
Industrial Program	278,791	33.03	8,441
Conservation in Agricultural Production	13,047	3.60	3,624

Program Measure	Total Cost 1978-1980	Expected Energy Savings in 1980 (1000 Btu's)	$ Cost per 1000 Btu's Saved
Life Cycle Cost Analysis	28,224	.86	32,819
Commercial Buildings Self Audits	259,974	9.60	27,081
Commercial Buildings Building Automation Study	50,000	.18	277,778
Local Government Energy Management	686,388	1.03	666,396
State Government Energy Management	59,599	1.08	55,184
Community Energy Management	172,896	3.42	50,554
K-12 Conservation Education	465,266	5.2	89,474
Community Education Road Show	102,474	.90	113,860
State Administration	171,674		
TOTAL	3,003,912	85.25	

Attachment 4-F

EXCERPTS CONCERNING SEATTLE FROM "LOCAL GOVERNMENT ENERGY ACTIVITIES"
U.S. Department of Energy, July 1979

Note: This was a detailed analysis of the energy conservation programs and activities presently being conducted in twelve cities and counties.

"The four communities with broad energy policies are Minneapolis, King County, Seattle, and the City of Los Angeles."

"The only community-oriented plan which includes a quantified goal is Seattle's."

"With the exception of Seattle...most of the governments have very few staff officially assigned to energy."

"The size of local commitment to an ongoing program ranged from Alameda County, which has no energy coordinator or specific conservation program, to the $3 million provided by Seattle City Light's operating revenues and $3 million in capital improvement funding for the city's conservation program (FY 1979).

"Seattle City Light is probably the premier example of how a municipal utility can help in carrying out a local government's energy policy. SCL has the lead in convincing and assisting residents, businesses, and industry to moderate their demand sufficiently to avoid the need to constrict the 230 MW of generating capacity otherwise projected to be necessary by 1990. The utility's Conservation Office was established by the City Council in order to implement this policy, and works closely with the City Energy Office under the Mayor. ... In addition to helping customers conserve, SCL is investigating centralized and decentralized uses of renewable resources appropriate for the Northwest. This interest in new technology is part of the search for alternatives to conventional generating capacity."

"Seattle City Light has funded the city's Department of Community Development to analyze the institutional and legal barriers to solar use, and expects to use the results to change local ordinances and codes."

"With the exception of Seattle, very little data is collected on the progress and impact of community oriented programs. ... Seattle City Light has developed a computerized system to monitor their community programs, and has established a plan and schedule for evaluating their progress."

"Seattle cut their fuel consumption about 20% between 1972 and 1978."

"The general pattern in the jurisdictions surveyed is a lack of citizen involvement and a correspondingly low priority given to energy by many local officials. The most dramatic exception is Seattle. Seattle was faced with a decision on whether the municipal utility should buy into two new nuclear power plants. In response, the city launched 'Energy 1990,' a fourteen month examination of possible energy futures, which was supervised and evaluated by a board composed of citizens. There were public hearings and extensive coverage of the process in the media. A large part of their current conservation program is oriented toward citizens. The city has five active citizen committees dealing with electric rates, service requirements, a cooperative agreement with the Department of Energy, planning for the city's CCEMP grant, and outdoor/decorative lighting. The participants feel that the widespread public involvement has had a variety of benefits, including: (1) Development of an educated, sophisticated body of citizens and consumers. (2) Legitimization of energy as an issue for voters and public officials. (3) Laying of the foundation necessary for successful implementation of a conservation program requiring active public support and participation."

Attachment 4-G

SEATTLE CITY LIGHT

OFFICE OF CONSERVATION PROGRAM ACTIVITIES

The Seattle City Light Conservation Office has many program activities which can be included in six major project categories: Commercial/ Industrial; Residential; Education/Outreach; In-House Conservation; Research, Development and Demonstration; and Support Activities. Below are listed examples of the projects within each end-use sector.

COMMERCIAL/INDUSTRIAL

Energy Management Seminars and Workshops are conducted for City Light customers to facilitate energy management training. For example, workshops to be held in the Duwamish Valley have been planned which are jointly sponsored by Seattle City Light, the Puget Sound Air Pollution Control Agency (PSAPCA) and the Seattle Chamber of Commerce.

Energy Management Advisory Services which focus on lighting surveys as a means to determine potential savings. (In 1979 thirty-three in-depth surveys were completed and 469 KW were identified as potential savings.

Revision of Service Requirements project which aims to establish efficiency standards that will reduce energy requirements for new commercial/industrial loads by 15% by 1982.

RESIDENTIAL

The Insulation Demonstration Program has resulted in the insulation of nearly 200 homes and other customers are in various stages of contract approval.

The Home Energy Check Program has been very successful, with an expected 5,000 Home Energy Checks to be completed during 1979. The Home Energy Auditors perform heat loss calculations through the use of DOE's Project Conserve and advise residents on methods available to reduce heat loss. In addition, Home Energy Auditors set back water heater thermostats and wrap water heaters for further KW savings.

EDUCATION/OUTREACH

An Energy Information Center, located in the City Light Building, provides public access to program information and conservation techniques. Thermographic photographs of the Seattle area are also available for viewing. The Education/Outreach programs also include participation in such events as Teacher Workshops, the Environmental Faire, and Solar '79 Northwest, to name a few.

Under a grant provided by the Department of Energy, consultants were chosen to develop a graduate level course curriculum on urban energy management programs which is being taught this fall at Seattle University.

IN-HOUSE

The In-House conservation efforts included preliminary audits of 28 City Light facilities as part of the Department of Energy School, Hospitals and Public Buildings Program. City Light's Commercial/ Industrial Energy Management Consultants followed up with detailed audits and are now developing a comprehensive energy management plan for the utility.

RESEARCH AND DEVELOPMENT

The Neighborhood Conservation Demonstration program awards contracts to individual or community projects.

The Odessa Brown Children's Clinic was awarded a federal HEW grant to provide funds for its solar demonstration project which is to design and construct an active solar component for this new children's clinic.

The Transformer Waste Heat Utilization Program plans to demonstrate the use of waste heat from the Broad Street Substation transformer to provide 70% of the space heat and up to 50% of the hot water heat at the Pacific Science Center.

The Project Weathervane project monitors a residential solar system retrofit for supplemental space and water heating and a residential windmill system for electrical support to the home.

SUPPORT

Support activities have focused on the analysis and preparation of written comments relating to the proposed rules for implementation of the National Energy Conservation Act (NECPA). Legal analysis, drafting of testimony and assistance in legislative drafting were provided in support of SJR 120.

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SESSION 5. TECHNIQUES OF ENERGY PLANNING

Student Outline

A. Energy demand forecasting

1. Rationale for demand forecasting

    a. High costs of over- and under-building

    b. Long lead-times for resource development

2. Methods of demand forecasting

    a. Trending

    b. Econometrics

    c. End-use analysis

    d. Input-output analysis

B. Energy economics and pricing

1. Guidelines for energy pricing

    a. Natural monopolies

    b. Cost of service

    c. Joint outputs

2. Effects of pricing guidelines

    a. On allocation of resources

    b. On the distribution of energy

3. Problems in energy pricing

    a. Inefficiency of average cost pricing

    b. Revenue imbalances

    c. Planning-pricing paradox

SESSION 5. TECHNIQUES OF ENERGY PLANNING

Reading Assignment

John Sawhill, Energy Conservation and Public Policy, Ch. 2

Seymour Warkov, Energy Policy in the United States, Ch. 12

John Gibson, "Energy Demand Forecasting," Attachment 5-A

John Gibson, Energy Economics and Pricing," Attachment 5-B

Suggested Reading:

Freeman, David S. 1974, Energy: The New Era. New York: Random House, pp. 138-57

Attachment 5-A

ENERGY DEMAND FORECASTING

John Gibson

Energy demand forecasting is the basis for supply planning, or predicting when and how much new supply will be needed. It has become a highly visible and controversial subject recently.

Two different rationale are commonly given for this kind of energy analysis: (1) the high costs of over- and under-building of production facilities, and (2) the long lead-times required for resource development.

High costs of over- and under-building. Forecasting is important in direct proportion to the cost of inaccurate resource development timing. Currently the cost of premature building or investment is very high. For electricity it has increased by an order of magnitude during the past decade in the Pacific Northwest. The cost of late development of energy resources is also high, as it has been all along. Energy is an important factor in many sectors of the economy, besides being vital to the comfort of consumers.

Long lead-times for resource development. In addition to the high costs of inaccuracy, energy development planning is subject to a high probability of being incorrect. This results from the long period of time from the initiation of a new supply plant's construction planning until the plant finally begins supplying energy. Lead times of ten to fifteen years are common, and require forecast accuracy for that number of years into the future.

Energy forecasters use a variety of methods, with the choice in a particular situation governed by the available data, the degree of stability expected in the energy market in the future, the cost of inaccuracy, and whether the forecast is to be used for resource development timing or to suggest policy directives or both. The four methods discussed here are (1) trending, (2) econometrics, (3) end-use analysis, and (4) input-output analysis.

Trending. The simplest and crudest of the common energy forecasting techniques, trending works on the principle of extrapolation. It projects a continuation of past growth rates, often modified by recent variations in those trends and by other judgemental factors such as known major demand additions or cessations. The process requires two implicit assumptions: (a) that future economic and demographic conditions affecting energy demand will represent a smooth continuation of past conditions; and (b) that consumers will continue to react in the same way they have in the past to economic and demographic "stimuli." Trending is appropriate when these assumptions are accurate -- particularly the assumption that conditions will be a smooth continuation of the past. In addition, if the costs of error are low, trending may be acceptable. It is inexpensive. It also requires a situation that demands little policy guidance from the forecast, since it does not disaggregate the probable influences of individual variables on total energy demand.

Econometrics. This technique identifies the separate role of each key variable that influences energy demand, using statistical means. It then forecasts the values of the underlying economic and demographic variables and calculates the demand level they are likely to generate. Econometrics assumes that patterns of people's responses to economic and demographic conditions will be the same as in the past. It does not have to assume a continuation of past conditions, however. It does require considerable empirical data in order to establish statistically reliable relationships among the key variables. Econometrics is an appropriate forecasting tool when the costs of error dictate an accurate forecast, and when the future conditions are expected to depart significatly from past trends. It guages responses, separately for each causal variable, that will presumably mark people's behavior under the new conditions. By identifying the separate roles of many variables in producing total energy demand, it is also useful for guiding policy decisions by providing estimates of their various impacts.

End-use analysis. The term "end-use forecasting" is used to denote two separate approaches. One is simply econometric forecasting disaggregated according to the end-use. The other is a distinct forecasting method utilizing an engineering "building-block" approach. The engineering physical requirements for energy are calculated separately for each type of end-use, and then summed. For example, it would estimate the energy requirements for heating, lighting, hot water, and appliances in a typical house, sum these, and then multiply that single-dwelling total by the number of such dwelling units in the community to arrive at an energy projection for the residential sector. This technique is a forecast from first principles. It uses technical relationships to derive energy requirements. But it must make judgements about the structure of typical buildings and engines; the energy efficiency of appliances, motores, etc.; and how they will or should change over time in resonse to different prices, incomes, and other factors. By design, this technique requires broad, unverified judgements in areas where other methods rely on data, such as in guaging consumers' responses over time to shifting influences. It is therefore inappropriate for prediction. On the other hand, because it builds on design requirements, end-use analysis is well suited to setting goals or lower limits for energy use, and also to estimating the potential impact of conservation programs and other policies designed to manage energy demand.

Input-output analysis. I-O Analysis reconstructs the economy in terms of the amount of inputs of various sorts that are needed to produce a unit of output in each separately identified category. This allows the analyst to trace the interrelationships among many sectors of the economy. One sector which serves as both an input and an output is energy. Working "backward" in effect, I-O Analysis can calculate the amount of activity and production necessary in each sector to produce a net combination of finished goods. Thus, from broad predictions of economic growth and mix, one can determine the energy requirements, both direct and indirect. Construction of an I-O model requires a great body of data, and often runs into difficulty when attempted on a local or even a sub-regional scale. It also requires an assumption of static input-output relationships in all the identified sectors. This assumption can be avoided, but only with the heop of separate econometric modeling for the various sectors. I-O Analysis is most useful for situations in which its static nature is not a serious handicap. Thus it is a poor technique for forecasting future demand. However, it can provide useful information on the relationship of energy and jobs in a static situation, or on the employment impacts of conservation versus energy generation.

Attachment 5-B

ENERGY ECONOMICS AND PRICING

John Gibson

Despite a growing sense of resource scarcity, the pricing of energy has not been a subject of widespread public concern until fairly recently. However, academics and regulatory bodies have long recognized some inherent features of the major energy industries that call for special pricing treatment. In particular, these are the "natural monopoly" status of these industries and their occasional technological discontinuities in supply.

Three general guidelines have traditionally directed energy pricing: (1) natural monopolies, (2) cost of service, and (3) joint outputs.

Natural monopolies. The major energy production industries -- electricity, oil, and natural gas -- are all run most efficiently as monopolies over some geographic scale. This is due to technological factors. In the case of electricity and gas, the costs of distribution and delivery are less if costly duplication is avoided. Thus within any geographic area there is usually just one supplier, although the size of these spatial monopolies varies. Two methods are employed to prevent these monopolies from extracting inordinate profits, while preserving their efficiency edge. One is public ownership, while the other is regulation. Both work to keep prices reasonably low and output high, allowing only a "fair" rate of return. The typical tool is average cost pricing. Basing prices on the average cost, it enables the industry or utility to break even, but limits the profit which would lead in these natural monopolies to higher prices and less output.

Cost of service. Calculations of the cost of service not only institutionalize average cost pricing, but also establish the acceptable basis for price discrimination by the energy industries among their various types of customers (e.g., industrial, commercial, and residential). This can also constrain the policy uses of pricing.

Joint outputs. Electricity is peculiar for having several distinct dimensions from the consumer's standpoint. Besides being accessible (with some accompanying cost), it must be capable of meeting the sum of all customers' requirements over the year and capable of meeting the maximum simultaneous, or peak, demands of the customers. Each of these capabilities involves some costs, and since customers require these three services in different proportions, equity requires separately identifying and pricing the facilities' appurtenant to each service for each class of customer.

The above pricing guidelines have considerable influence on both the allocation and distribution of energy.

Allocation of resources. The allocation of resources stems from the price-demand relationship. Recent and anticipated further jumps in energy prices which were once fairly stable have focused attention on price elasticity, or the magnitude of the change in quantity demanded that accompanies a given price change. This has illuminated several prospects: (a) as prices are required to rise, following the traditional average cost model, the effects of price elasticity will retard the growth of demand, which is an important consideration for resource planners; (b) prices have a strong potential for directing energy use, if wielded as a policy tool; (c) the use of average cost pricing as the prevailing method has allocational consequences, since when new resources are vastly more expensive, average cost pricing encourages overdevelopment of them.

Distribution among customers. Pricing can affect the distribution of energy among groups of customers. If the costs attributed to one group are underestimated, that group not only receives a cost break, but because of the elasticity effect it also consumes a higher proportion of the energy available. This allows policy makers to do three things: (a) influence the mix of employment by favoring certain types of users; (b) achieve some income redistribution by lowering costs and thus increasing indirectly deliveries to certain users; and (c) influencing overall consumption levels by shifting the costs (and thus prices) between two groups with different elasticities of demand with respect to price.

There are numerous problems in the energy pricing process, including (1) the inefficiency of average cost pricing, (2) revenue imbalances, and (3) the planning-pricing paradox.

Inefficiency of average cost pricing. Average cost pricing does not inform consumers of the cost of new resources in most cases. When new resources are cheaper, this results in their under-development; when they are more expensive it results in over-development. The generic solution is marginal-cost pricing, which accurately signals the cost of expansion.

Revenue imbalances. If output is priced at the marginal cost, the result is too little or too much revenue. Too little revenue is generated if new units of output are cheaper than the average, and too much revenue is generated if new units are more expensive than average -- which is the current case. Inadequate revenue requires some form of subsidy, which preferably doesn't meddle with the now-efficient prices, while surplus revenue requires some equitable form of rebate or other disposal process that doesn't alter the efficient prices.

Planning-pricing paradox. If new resources are much more expensive than existing resources, average cost pricing causes a dilemma. It causes early development, but incurs so great an additional cost that demand is depressed below the old capacity. If the development did not occur, however, there would be shortages at the average cost. Marginal cost pricing, on the other hand, would be unstable, and could also produce surplus revenue and redundant capacity. A solution is Long-Run Incremental Cost (LRIC) pricing, which would simply ration low-cost resources by gradually raising rates over time until they would support the development of the new high-cost resources. This would generate surplus revenue.

SESSION 6. TECHNIQUES OF ENERGY CONSERVATION

Student Outline

A. Principles of energy conservation

1. Characteristics of energy usage

   a. Role of energy in modern society

   b. Measuring energy consumption

   c. Technological change versus social change

2. Determinants of energy usage

   a. Price of labor and associated capital costs

   b. Convenience of use

   c. Climate and other geographical factors

3. Definitions of energy conservation

   a. Reduction in the consumption of energy

   b. Reduction in the consumption of non-renewable resources

   c. Improved efficiency in energy use

4. Opportunities for energy conservation

   a. Reducing energy intensiveness in existing systems

   b. Reducing energy intensiveness in new systems

B. Energy conservation in buildings

1. Space heating

   a. Energy use patterns in residential and commercial buildings

   b. Heat loss processes

   c. Conservation techniques in buildings

   d. Heat gain in buildings

   e. Integrated systems in commercial buildings

   f. Potential energy savings in buildings

2. Appliances, equipment, and lighting
    a. More efficient household equipment
    b. More efficient commercial equipment

C. Energy conservation in transportation
1. Energy use for transportation in urban areas
    a. Distribution of energy consumption by type of transportation
    b. Calculation of energy consumption by automobiles
2. Local transportation conservation measures
    a. Three key factors
    b. Specific actions available to local governments
    c. Electric cars

D. Energy conservation in industry
1. Energy use by industry
    a. Distribution of industrial energy consumption by end-use
    b. Calculation of energy consumption by industry
2. Current technological needs and prospects
    a. More efficient furnaces, boilers, and heat recovery devices
    b. Improved electric moter efficiencies
    c. Computerized control systems for industrial processes
    d. Recycling, recovery, and reuse of materials
3. Local community potentials
    a. Synergistic arrangements
    b. Co-generation
    c. Technical assistance and financial incentives

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SESSION 6. TECHNIQUES OF ENERGY CONSERVATION

Reading Assignment

Robert Stobaugh and Daniel Yergin, Energy Future, Ch. 6

John Sawhill, Energy Conservation and Public Policy, Chs. 4-6

Barry Hyman, "Principles of Energy Conservation," Attachment 6-A

Barry Hyman, "Energy Conservation in Buildings," Attachment 6-B

Barry Hyman, "Energy Conservation in Transportation," Attachment 6-C

Barry Hyman, "Energy Conservation in Industry," Attachment 6-D

Attachment 6-A

Principles of Energy Conservation

Barry Hyman

1. Characteristics of Energy Usage

Energy is the primary substitute for human and animal labor in a technological society as the principle mechanism for performing work. Energy consuming activities are associated with all major endeavors of a technological society including the production of material goods, transportation, communication, public health and safety and environmental conditioning. Any end-use activity has associated with it a stream of energy consuming activities associated with conversion of the natural resource to utilization at the point of end-use.

For example, the process of providing a container of milk for personal consumption requires the expenditure of energy for providing feed for the cows; for milking the cows; for processing the milk and packaging it; for transporting and maintaining the milk under refrigerated conditions to processing plants, warehouses, local grocery stores, and finally the household refrigerator.

The amount of energy consumed in any activity can be expressed as:

$$\text{total energy consumed} = (\text{energy consumed per unit of activity}) \times (\text{extent of the activity})$$

The energy consumed per unit of activity is called the energy intensiveness of the activity. Thus, when we examine opportunities to modify the energy consumption associated with an activity, we can examine either opportunities for modifying either the energy intensiveness of the activity or the extent of the activity. This division of energy consumption into these two major factors reveals that approaches to energy conservation can focus either on technological changes aimed at reducing energy intensiveness or social changes aimed at reducing the extent of the activity.

2. Determinants of Energy Usage

Before exaimining opportunities to modify current energy consumption patterns, it is well to identify several factors which strongly influence such patterns and are responsible for current patterns.

Since energy is a direct substitute for labor, the relative prices of energy and labor influences the extent of this substitution. However, since both energy and labor usually require capital investment in either energy using or labor using equipment, these capital costs are an additional determinant of the energy/labor tradeoff.

Certain forms of energy are more convenient than others for specialized applications. Electricity is particularly well suited for operating clocks, radios and a myriad of household, commercial, and industrial devices. Petroleum products cacause of the high amount of energy contained within a given volume, is particularly convenient for use in transportation vehicles.

Since heating and cooling of buildings is a major use for energy [redacted], local slimate conditions will have a significant affect on energy consumptions. Other geographical factors, such as the location of oil fields and coal deposits, and the presence of mountain ranges combined with rain and snow patterns which provide opportunity for hydroelectric power, will also strongly influence energy usage patterns.

Other factors influencing energy usage are population patterns, general economic conditions, cultural attitudes, and institutional entities (suggested student exercise: discuss how each of the aforementioned affect energy usage)

3. Definitions of energy conservation

The widely used term "energy conservation" has many different conotation , and there is no single widely agreed upon definition. Therefore, it is important that we be alert to the different utilizations of the term. Three alternative definitions of energy conservation are presented below:

a. energy conservation: the reduction in usage, or the reduction in anticipated future usage, of energy.

b. the reduction in usage, or the reduction in anticipated future usage, of certain forms of energy resources.

c. the improvement in the efficiency with which energy is used. This definition in particular can invoke alternative concepts of efficiency derived from thermodynamics:

i. efficiency is the ratio of the useful output of energy consuming activity to the energy used to carry out the activity (output/input). Thes concept is derived from the first law of thermodynamics.

ii. efficiency is the ratio of the least amount of energy theoretically required to perform an activity to the actual amount of energy used to carry out the activity (minimum input/actual input) this concept is derived from the Second Law of Thermodynamics and is related to the concept of "not using a chainsaw to cut butter".

None of the above definitions address themselves to the question of how much energy conservation is feasible or appropriate in any given set of circumstances. This is because energy usage (or energy conservation) is not an end in itself, a means towards an end, specifically the accomplishment of a task (doing work). Other factors, such as the cost of accomplishing the task, the time required to accomplish the task, the individual and public hazard of performing the task, the environmental consequences of performing the task and the political implications of the task, need to be considered before concluding what level of energy conservation is feasible or appropriate. Obviously, the extreme case of ignoring all these other factors can lead to significant "energy conservation" under definitions a. and b. above iffthe extent of the activity was reduced to zero, e.g. ban automobiles!!!

4. Opportunities for Energy Conservation

As indicated earlier, energy conservation opportunities can be considered to be in two major categories: opportunities for decreasing the extent of an activity, and opportunities for decreasing the energy intensiveness of an activity.

For example, the energy associated with heating a house can be expressed as

energy for home heating=(energy expended for heating per sq. ft. of floor space) x (number of sq. feet of floor space in home)

We can conserve energy for home heating by building smaller homes perhaps in response to smaller family size) or by decreasing the energy intensiveness (heating energy per square foot of floor space) of a typical home.

Techniques for accomplishing changes of either kind will be discussed in later lectures of this course. For now, we will discuss in more detail several generic opportunities for reducing energy intensiveness.

There are major opportunities for reducing the energy intensiveness of existing systems. They can be categorized as follows:

a. leak plugging - isolated one-time action, usually with negligible capital investment(e.g., repair broken window in house)

b. improved maintenance - periodic actions required, small capitol investment (e.g., replace furnace filters more frequently)

c. modify usage patterns - continuous actions required, negligible capital investment (e.g. set back thermostat each night to 55F)

d. modification of existing systems (retrofit) - one time action consisting of physical modification of existing system, usually involving signfficant capital investment (e.g., adding attic insulation)

In addition, the adoption of new systems as substitutes for existing systems is another opportunity for reducing energy intensiveness. The new systems can involve existing technology (replacing an electric furnace by a heat pump) or the development of new technologies (using the waste heat from a refrigerator to preheat water entering water heater).

PART II - Sectoral analysis - survey of energy conservation opportunities in the transportation and industrial sectors. Though sectoral analysis is a convenient way to categorize and quantify energy consumption, it should be kept in mind that any particular end use activity frequency involves input energy from different sectors (see previous example of milk container), approximately 1 1/2 hours. Overly narrow attention to sectoral analysis can lead to conservation measures which achieve their objective within a sector to other sectors and perhaps even increasing leading to no (or negative) conservation associated with the same end use activity.

Attachment 6-B

Energy Conservation in Buildings

Barry Hyman

1. Space Heating

By far the single largest residential or commercial use of energy is for space heating. This energy is required to compensate for the heat loss from the warm interior of the building to the colder outdoor air. The daily heat loss from a building can be expressed in factored form by using the concept of degree-days to separate the climatic effects of building design features. Experience has shown that, on the average, a house does not require heating on a given day unless the average daily temperature falls below 65°F. We define the number of degree-days in a day as:

$$\text{degree-days per day} = 65^{\circ}F - T_{avg}$$

provided that T_{avg} is less than 65°F. We can then write

$$\text{heat loss per day} = \text{heat loss per degree-day} \times \text{degree-days per day}$$

Typically, it is convenient to express building heat losses in annual terms. Adding up the daily heat loses, we get

$$\text{annual heat loss from a building} = \text{heat loss per degree-day} \times \text{degree-days per year}$$

There are approximately 4500 degree-days per year in Seattle during a typical year. In locations with more severe winter climates (Spokane has about 6600 degree days per year), an identical building will lose more heat.

The three primary mechanisms by which heat is lost from a building are

(1) Conduction of heat through solid surfaces

(2) Convection of heat through motion of air along a solid surface

(3) Infiltration of cold air from outside and corresponding loss of warm air from the interior

The heat loss from all three sources can be reduced by reducing the amount of surface area exposed to the outdoors. This can be accomplished by selection of building form (e.g., apartments vs. town houses vs. single family homes) and architectural style (ranch style vs. two-story).

Conduction heat losses can be reduced by choice of building materials and components which have high resistance to heat conduction (e.g., double pane windows, shutters, ceiling and wall insulation). Convection-heat losses can be reduced by establishment of dead-air spaces (e.g., draperies in front of inside window surfaces, plantings or other wind-breaks adjacent to outside surfaces). Infiltration losses can be reduced by adoption of tighter construction practices and use of caulking and weather stripping to omit cracks around windows, doors, exhaust fans, keyholes, electric outlets. Placement of doors and frequency of door openings both affect infiltration rates.

In order for a building to remain confortable, the heat losses must be compensated for by heat gains. The four major sources of heat gain in buildings are

(1) Body heat from building occupants

(2) Heat given off by lights, appliances, and other equipment

(3) Solar radiation entering through transparent surfaces

(4) Heat added to buildings by space heating systems

Categories (1) and (2) are very important sources of heat gain in commercial buildings. In fact, it is not unusual for these heat gains

Attachment 6-B

in densely occupied, well-lit buildings (e.g., schools, restraunts) to be greater than the heat losses, thereby requiring air-conditioning of these buildings even during the heating season. However, for residential buildings, these contributions can be neglected when using heat losses calculated from a 65^{O}F basis.

Focusing for now on the heat added to the building by the space heating system, there are two major techniques for adding this heat:

(1) Heat addition through conversion of chemical or electrical energy in a furnace or (in the case of electricity) resistance heating elements. A natural gas or oil furnace will typically operate at a conversion efficiency of 50%-80%, while an electric resistance heating system is 100% efficient. (Note, however, that if the electricity was generated in a thermal power plant, the power plant and transmission system efficiency is 24%-35%).

(2) Heat addition through transfer of thermal energy from some low-grade energy source external to the building. This process utilizes the fact that every system at a temperature of greater than absolute zero contains thermal energy which can in principle be extracted and transferred as heat to another system. The most common application of this concept is the household refrigerator, which extracts thermal energy from the (cold) interior of the refrigerator and transfers it as heat to the (warm) kitchen. The only energy required is that needed to operate the pump and compressor to circulate the refrigerant. When applied to space heating, the system is called a heat pump, and the low-grade energy

source can be either the outdoor air, the ground, or a body of water. Heat pumps can typically transfer from one to three units of energy to the building for every unit of energy required to operate the equipment. (Heat pumps operating in reverse are called air-conditioners.)

Opportunities for improvements in space heating systems include improved design of furnace burners, flue dampers, and control systems which allow heating systems to operate at maximum efficiency.

In commercial buildings, space heating systems are usually part of a larger integrated system which also provides ventilation, humidification, and air conditioning. These systems, in addition to being custom designed, usually require the frequent attention of operations and maintenance personnel to operate at maximum efficiency. Installation of computerized control systems in large commercial buildings can allow for continuous monitoring and adjustments in heating, ventilation, and air-conditioning systems. Capturing waste heat in commercial structures is another conservation opportunity. Also, different portions of a given building may require heating and cooling simultaneously, so transfer of heat between these zones can be utilized.

An important serendipitous effect is that reductions in heat loss rates of buildings can result in cost-savings as well as efficiency improvements associated with smaller heating systems.

While estimates of potential improvements vary from building to building, it is generally agreed that cost-effective improvements in building and heating system design using commercially available technology can reduce energy requirements for space heating of new buildings by 1/3 to 2/3 in comparison to buildings completed in the 1950's and 1960's.

Attachment 6-B

2. Appliances, Equipment, and Lighting

Efficiency improvements of from 10% to 30% are expected by 1980 in major household appliances in comparison to 1972 levels. These improvements are the result of improved insulation characteristics of refrigerators, freezers, water heaters, plus use of more efficient compressors and heat exchangers. New technologies such as heat pump water heaters and integrated appliances which capture waste heat can lead to even greater efficiency improvements.

Even more impressive conservation opportunities are associated with efficiency improvements in commercial equipment such as refrigerated food display cases in grocery stores, and commercial equipment such as office machines, restaurant cooking and dishwashing equipment, escalators and elevators. Use of high-efficiency lighting systems which are task oriented as replacements for space oriented incadescent lighting also has significant conservation potential.

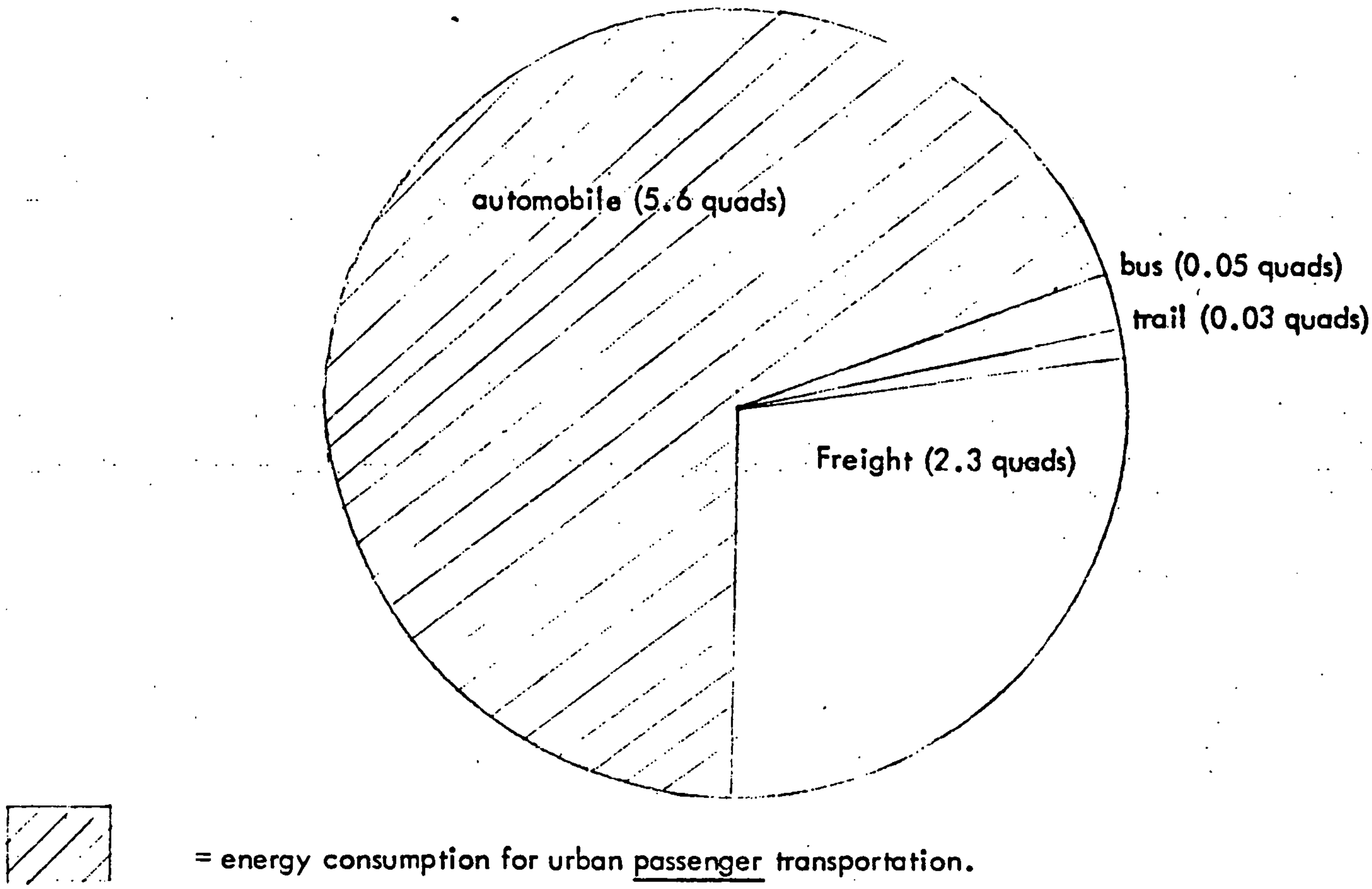
Attachment 6-C

Energy Conservation in Transportation

Barry Hyman

This is a particularly important sector because it is almost exclusively concerned with petroleum utilization. The distribution of energy consumption for urban transportation is shown in Figure I. Because of the dominant role played by the automobile - most conservation efforts to date have focused on the automobile.

Figure 1.
ENERGY CONSUMPTION FOR URBAN TRANSPORTATION IN 1970



Ref: Hirst, Energy Intensiveness of Passenger and Freight Transport Modes, ORNL-NSFOEP-44; 197

Using the approach outlined earlier, we can write:

energy consumed by automobiles in urban areas = energy consumed by automibiles for passenger mile in urban areas x number of passenger-... associated with auto travel in urban areas

The energy intensiveness can be further broken down into two components

(energy consumed by automobiles per passenger mile in urban areas) = (energy consumed by automobiles per vehicle-mile in urban areas — (passengers per vehicle)

specific fuel consumption — occupancy level

The extent of the activity can also be further broken down into two components

(number of passenger-mile)=passenger trips) x $(\frac{\text{miles}}{\text{trip}})$

A more detailed breakdown is possible by dissagregating autonobile usage according to the purpose of the trip (i.e. - work, family business, social and recreational). Within each trip-type the four major factors, (passenger trips, trip-length, specific fuel consumption, and occupancy level) could be examined. The specific fuel consumption is primarily determined by the vehicle design, and as discussed in readings (Sawhill, pp. 79-96) has received considerable attention at the federal level through adoption of fuel economy standards.

At the local level, conservation measures can focus on the other three factors:

a. reducing the number of passenger-trips made by automobile (encourage use of more energy efficient modes of transportation-bus, bicycle, walking)

b. reduce average trip length (land use planning measures)

c. increase occupancy level (incentives for car pooling)

However, even with respect to specific fuel consumption, local governments can exert leverage through procurement and maintenance programs for government owned fleets.

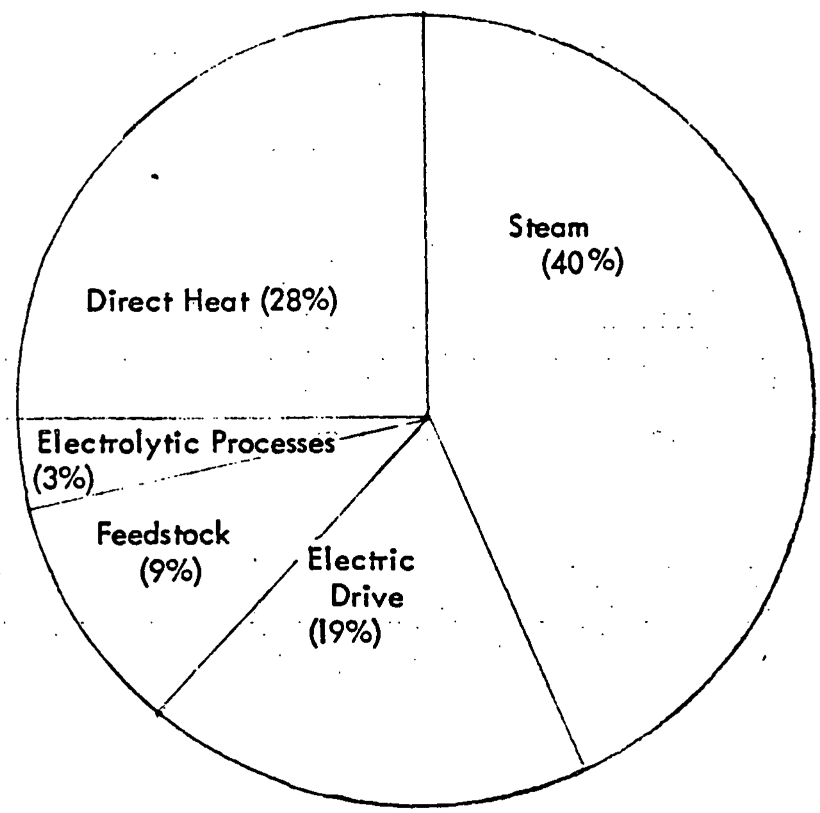
There is increased interest in electric automobiles as an alternative technology with particular application in urban areas. While not necessarily more energy efficient, these vehicles can operate on electricity generated from non-petroleum fuels. Urban areas need to focus more on the opportunities and potential problems associated with a possibly significant trend over the next decade in this area.

Attachment 6-D

Energy Conservation in Industry

Barry Hyman

The diagram discussed in Session I showed that industry consumes more than 40% of the energy in this country, and indicated the distribution of energy consumption among different industries. Another view of the illustration is on the next page where industrial energy consumption is disaggregated according to the nature of the activity.



As with the transportation sector, factorization of industrial energy consumption into terms involving energy intensiveness on the one hand, and the extent of the activity on the other, will assist in developing a better understanding of usage patterns and identifying major opportunities for conservation.

As with the transportation sector, there are major federal and private industry efforts already underway to reduce energy intensiveness through adoption of new technologies. Since energy consumption in the industrial sector is dominated by processes involving heat, particular emphasis on more efficient furnaces, boilers, and heat recovery devices is appropriate. Another particularly promising activity are prospects for significantly electric motor efficiencies through use of devices that can be added on to existing motors. Computerized control systems for regulating complex industrial processes are another area with high potential for reducing energy intensiveness. The energy savings associated with recycling, recovery and reuse of materials is also quite substantial (Sawhill, pp. 168-193).1

Within specific industries, new process developments and product design provide many opportunities for energy conservation. A reminder, however, that focusing only on a given industry or sector can be misleading. For example, the greater use of energy-intensive aluminum in automobiles may increase production and thus energy consumption in the aluminum industry, but can lead to energy savings in the use of automobiles (transportation sector) which more than offset the increment associated with aluminum production.

The opportunities for industrial energy conservation in any particular urban area obviously depends on the pattern of industrial activity (within that area). Particularlyu worthwhile investigating are the opportunities for synergistic arrangements whereby high temperature waste heat from one company can be recovered to meet the low temperature requirements of aneighborhong company. The combined on-sote production of steam and electricity at an individual industrial facility or for an entire complex of facilities has great potential for reducing energy intensiveness.

Local government can also play a major role in providing technical assistance and financial incentives for small industries regarding energy conservation.

SESSION 7. TECHNIQUES OF RENEWABLE ENERGY PRODUCTION

Student Outline

A. Principles of renewable energy production

1. Concepts
   a. Renewable energy resources
   b. Solar energy
2. Types of renewable resources
   a. Biomass
   b. Solar radiation
   c. Water
   d. Wind
3. Characteristics of renewable resources
   a. Extent
   b. Distribution
   c. Quality
   d. Energy potential
4. Local management of renewable resources
   a. Relevant national policies
   b. Possibilities for local action
   c. Limitations and barriers to local action

B. Substitute fuels

1. Municipal wastes
   a. Feasibility of use
   b. Composition
   c. Techniques for converting wastes to energy
2. Other sources
   a. Forest products and wastes
   b. Agricultural crops and wastes

C. Direct Solar Heating

1. Passive solar heating

a. Concept

b. Techniques

c. Effectiveness

d. Barriers to adoption

e. Costs

2. Active solar heating

a. Process

b. Equipment

c. Advantages

3. Solar water heating

a. Present use

b. Feasability

D. Electricity generation

1. Technologies using renewable resources

a. Solar thermal electric power

b. Photovoltaics

c. Wind

2. Other technologies

a. Fuel cells

b. Cogeneration

c. Total energy systems

3. Advantages and disadvantages

a. Advantages

b. Limitations

c. Policy issues

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SESSION 7. TECHNIQUES OF RENEWABLE ENERGY PRODUCTION

Reading Assignment

Robert Stobaugh and Daniel Yergin, Energy Future, Chs. 7, 8

John Sawhill, Energy Conservation and Public Policy, Chs. 8, 9

Stephen Lyons, Sun!, pp. 147-169, 226-253

Barry Hyman, "Substitute Fuels," Attachment 7-A

Barry Hyman, "Direct Solar Heating," Attachment 7-B

Barry Hyman, "Electricity Generation," Attachment 7-C

Attachment 7-A

SUBSTITUTE FUELS

Barry Hyman

There are several substitutes and supplements for petroleum and natural gas that may be developed as part of an urban management program. The primary source of such alternative fuels is the municipal waste stream. This waste stream includes household, commercial, and industrial wastes as well as municipal sewage. The feasibility of any of these serving as a significant energy source depends on the size and density of population and/or industrial activity in the particular urban area, constituents of the waste stream (which can vary significantly from one urban area to another), costs of collection and processing, relative availability and costs of alternative disposal methods, and the market for the separable non-organic components. Shown below is the composition of typical U.S. municipal waste:

PHYSICAL COMPOSITION OF TYPICAL U.S. MUNICIPAL WASTE

Type of Material	Percent
Paper	50.7
Food waste	19.1
Yard waste	--
Metal	10.0
Glass	9.7
Wood	2.9
Textiles	2.6
Leather, rubber, and plastics	3.3
Miscellaneous	1.7
Total	100%

Several approaches to converting municipal waste to useful energy are discussed briefly below:

(1) Incineration. Solid waste can be burned to produce steam for space heating or industrial use, hot water, or electricity.

Depending on moisture and Btu content, the waste can be burned by itself or mixed with coal or oil. Systems have been operational for more than a decade in dozens of European cities, and are beginning to be adopted in American cities (e.g., Akron, Nashville, St. Louis).

(2) Pyrolysis. Processed solid wastes are heated in the absence of oxygen, and yeild either a gaseous or a liquid fuel. Pyrolysis plants have been built in Baltimore, Bridgeport, and San Diego.

(3) Bioconversion. Bacterial action on organic solids or sludge can yield methane (which is the principal ingredient of natural gas). Many sewage treatment plans produce methane for use in the plant operation. Decomposition of wastes in municipal land-fills produces methane which can be tapped and fed into the natural gas pipelines as is being done near Los Angeles.

Attachment 7-B

DIRECT SOLAR HEATING

Barry Hyman

In this section, we consider the use of solar radiation to provide space and water heating in buildings.

1. Passive Solar Heating

Passive solar heating refers to the heat added to a building through direct passage of solar radiation through a transparent surface into the occupied space of the building, and the subsequent storage and circulation of heat with no or minimal reliance on mechanical systems. Passive solar systems usually are an integral part of the architectural design of the building, and rely on building geometry and construction materials to achieve the desired effect. Techniques range from use of expansive glass areas on south-facing walls, to house geometies which are conducive to natural circulation patterns (e.g., "primitive" designs discussed in Lyons), to use of massive walls and floors to serve as heat storage systems. Many passive solar systems rely on either manually operated, thermostatically controlled, or photo-activated vents, louvers, or shades to control interior temperatures within a desired temperature range. Most passive solar systems have to be incorporated into the original design of the building, although the retrofit of existing buildings through the addition of greenhouse-type additions on south-facing walls is workable in selected applications.

It is ually not practical to design a building so that solar energy (active or passive) can supply 100% of the heating requirements, so generally provision has to be made for a backup system to provide supplementary heating during the coldest/cloudiest days. However, many well-designed solar passive houses which incorporate optimum energy conservation features need only a small wood-burning stove for supplementary heating.

One of the major barriers to adoption of passive solar techniques in new residential construction is that most single-family homes are not designed by architects, and typical homebuilders are not familiar with the design techniques needed for successful passive solar homes.

Nevertheless, because the energy capturing and storage features of passive solar buildings are an integral part of the building structure, the premiums in first cost over conventional buildings tend to be relatively modest (except for those cases where a custom-designed solar house is compared to a tract house of standard design).

2. Active Solar Heating

Active solar heating systems rely on the absorption of solar energy in a series of collectors exposed to sunlight, and the transfer of that energy to a fluid (usually water or air) which is mechanically circulated through the collectors. The circulating fluid then transfers the energy to a storage facility (usually an insulated water tank or rock bin) from which it is reclaimed when needed to provide space heating.

Most active solar heating collectors are flat panels which are designed for installation on rooftops. Because these collectors are discrete pieces of hardward which are added onto the building (as opposed to the integral nature of passive systems), they can be manufactured on a mass production basis. Many large nationwide corporations, including Grumman, Reynolds, Corning, and Olin manufacture flat plate collectors. At the other end of the spectrum, relatively inexpensive flat plate collectors can be hand built using basic carpentry and/or sheet metal working skills.

There are many variations of collector design, including use of reflecting surfaces to enhance energy collection. Alternative forms of energy storage, such as eutectic salts, are also available. Building designs abound which utilize various combinations of active solar, passive solar, conservation techniques, and heat pumps to comprise an overall systems approach to space heating.

One of the advantages that active systems have over passive systems is that retrofit onto existing buildings is easier. Also, active systems can be incorporated more easily into new buildings which have otherwise conventional architectural design features.

Economic considerations usually dictate that active solar heating systems should be designed to meet from 40% to 70% of the annual space heating requirements of the building.

3. Solar Water Heating

Water heating is the second largest use of energy in the residential sector, as well as a major component of commercial energy use. Use of solar energy to provide hot water is a well-established technology. Prior to the introduction of low-cost natural gas in the 1940's there were approximately 50,000 solar water heaters installed in Florida. Today, there are hundreds of thousands of solar water heaters in Israel, and several million in Japan.

Generally speaking, solar water heating is the most commercially viable application of solar energy in this country. Because hot water requirements are more uniformly distributed over the year than space heating needs, the economics of solar water heating are usually more favorable than for solar space heating. Also, because the collector area and storage volume required for domestic water heating is considerably less than that required for space heating, solar water heaters can be more easily adapted to "conventional" house designs and retrofitted onto existing buildings.

Attachment 7-C

ELECTRICITY GENERATION

Barry Hyman

Most electricity generated in this country is produced in large central-station plants powered either by oil, coal, uranium, or falling water. Because of environmental, safety, and land-use considerations, the trend has been to locate such facilities in non-urban areas. There are signs that this trend may be reversing, and in this section we discuss a variety of electricity generation technologies that might have promise for adoption within urban areas. Generally, these conversion technologies range in size from 10 kw (enough for one or two homes) to tens of megawatts, in comparison to central station plants which usually have capacities of several hundred to a thousand megawatts.

1. Technologies Using Renewable Resources

(1) Solar Thermal Electric Power. Our earlier discussion of solar energy was limited to techniques for meeting the relatively low temperature requirements of space and water heating. In order to yield temperatures high enough to generate steam for electricity production, we have to use reflecting surfaces or lenses to concentrate the incoming solar radiation. Concentrating collectors of many different designs have been developed for use in generating electricity. Of particular importance for urban areas is the possibility of small dish-type tracking collectors which can be mounted on roofs of commercial and industrial buildings.

(2) Photovoltaics. This technology involves the direct conversion of sunlight to electricity in thin semi-conductor "solar cells,"

much like those used to power man-made orbiting satellites. Some of the particularly appealing features of photovoltaic devices are their modularity (it is easy to build up arrays of any desired size by combining standard size units), their passive nature (no moving parts, no noise, no air pollution), and easy integration into build-design concepts. The major barrier to the widespread adoption of photovoltaics is their high cost, although they already are cost-competitive in selected applications (navigation buoys, forect ranger stations, rural areas of developing countries). Intensive federal and private sector initiatives are underway to make these devices cost-competitive on a broad scale by 1985.

(3) Wind. Contrary to the image of the old Dutch windmill, there are literally dozens of advantaced technology concepts for converting the kinetic energy of the wind into electricity. These range from a several-hundred-foot-diameter windmill capable of generating 2 mw, to small vertical axis Darrieus (egg-beaters) devices of several kw capacity. Many advanced technology and aerospace corporations such as Alcoa, Boeing, Gruman, and Lockheed have developed windmills. Small, innovative entrepreneurs have also been successful in marketing windmills. The siting of windmills is strongly affected by the fact that a doubling of wind speed yields an eight-fold increase in power output of a given windmill. Also, at a given location, a doubling of windmill diameter yields a guadrupling of power output. Thus, there is strong incentive to select sites with high average wind speeds and that can accomodate a large device.

2. Other Technologies

(1) Fuel Cells. These are battery-like devices that rely on an external source of a hydrocarbon fuel to drive a chemical reaction

which produces electricity. Fuel cells are modular, quiet, clean, and have high efficiency. The first commercial demonstration of a utility operated fuel cell was recently installed by Con Ed in Manhattan. Further work on decreasing fuel cell costs and extending their lifetimes is necessary before widespread adoption is imminent.

(2) Cogeneration. One of the major uses of energy in industry is for the production of steam. Suppose a particular factory needed steam at 250^{o}F and 50 pounds of pressure in order to operate a given process. The factory could install a boiler to provide steam at, say, 500^{o}F and 100 pounds pressure, run that steam through a turbine to generate electricity, and have the steam exist from the turbine at 250^{o}F and 50 pounds pressure, ready for use in the industrial process. This joint production of electricity and steam is considerably more efficient than generating the electricity and steam separately. The electricity produced can either be used inside the factory or sold to the local utility company for distribution to its customers. Cogeneration is a well-developed technology. In fact, in the 1920's, many cogeneration systems were shut down as a result of antitrust action brought by utilities.

(3) Total Energy Systems. This is a variation on the cogeneration concept. It involves the use of an engine (frequently a dieser or steam engine) to produce electricity for a residential or commercial complex, with the exhaust from the engine used to provide the space heat and hot water needs of the complex. Because the energy content of the engine exhaust is utilized, the overall efficiency is higher than a large central station power plant which dumps the waste heat into the environment.

3. Advantages and Disadvantages

Several of the potential advantages of any of the above techniques for electricity production are:

(1) Shorter lead times reduce uncertainties in planning;

(2) Greater flexibility in siting;

(3) Reduced transmission and distribution costs.

On the other hand, increasing reliance on (intermittent) solar and wind technologies may not reduce a utility's need to provide sufficient capacity to meet peak load requirements unless techniques are found for making their output more dependable. Strategies which rely on energy storage techniques to smooth the output of intermittent generators are being developed. Using an existing hydro electric system to provide storage capacity for solar and wind energy has great potential

Because the technologies discussed are of relatively small capacity and are suitable for installation in conjunction with privately owned structures, they present fewer barriers to private ownership. The prospect of electric utilities losing their virtual monopoly on electricity generation raises some very important policy issues associated with regulation of the utility industry.

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SESSION 8. STRATEGIES FOR VOLUNTARY ENERGY MANAGEMENT

Student Outline

A. Introduction to implemention strategies

   1. A theoretical perspective

      a. The situation

      b. The challenge

      c. Three solutions

   2. The contexts of energy consumption

      a. Concept

      b. Major contexts

   3. Strategies for implementing change

      a. Goal determination

      b. Instrument selection

      c. Action identification

   4. Criteria for the implementation process

      a. SAM goals

      b. REF instruments

      c. POC programs

      d. RAC effects

      e. RIC outcomes

B. Principles of the voluntary approach

   1. Purpose

   2. Two forms

   3. Desirable features

   4. Undesirable features

C. Information techniques

   1. Main characteristics

      a. Intention

b. Theory

c. Instruments

d. Techniques

2. Problem awareness

a. Characteristics

b. Effectiveness

3. Technical information

a. Characteristics

b. Effectiveness

4. Consumption feedback

a. Characteristics

b. Effectiveness

5. Evaluation of information techniques

D. Mobilization techniques

1. Main characteristics

a. Intention

b. Theory

c. Instruments

d. Techniques

2. Neighborhood activities

a. Characteristics

b. Effectiveness

3. Organizational actions

a. Characteristics

b. Effectiveness

4. Community programs

a. Characteristics

b. Effectiveness

5. Evaluation of mobilization techniques

SESSION 8. STRATEGIES FOR VOLUNTARY ENERGY MANAGEMENT

Reading Assignment

Marvin Olsen and Bernward Joerges, "Policies for Promoting Consumer Energy Conservation," Attachment 8-A

Seymour Warkov, Energy Policy in the United States, Chaps. 8, 11

Marvin Olsen and Christopher Cluett, "Evaluation of the Seattle City Light Neighborhood Energy Conservation Program," Attachment 8-B

Suggested Reading:

Winett, Richard A., et al. "Effects of Monetary Rebates, Feedback and Information on Residential Electricity Conservation," Journal of Applied Psychology, Vol.63, No.1. 1978.

Craig, Samuel C. and McCann, John. "Assessing Communication Effects on Energy Conservation," Journal of Consumer Research, Vol.5, Sept. 1978 pp. 82-7

Attachment 8-A

POLICIES FOR PROMOTING CONSUMER ENERGY CONSERVATION: AN AMERICAN-EUROPEAN PERSPECTIVE

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I. THE PROBLEM OF CONSUMER ENERGY CONSERVATION

Although there is wide disagreement over the extent of the world's remaining oil and natural gas deposits (Energy Policy Project, 1974; Stockman, 1978), the inescapable fact is that these resources will be largely depleted within the lifetimes of many people living today. Industrial nations that depend heavily on these fuels must -- within a relatively brief period of time -- develop technologies for renewable energy sources and reduce their consumption of nonrenewable energy. If they fail in this endeavor they face economic and political disasters (Hayes, 1977).

Importance of Energy Conservation

The imperative need for alternative energy sources to replace oil and natural gas cannot be ignored or minimized. At the same time, industrial nations can take numerous actions to reduce their current levels of energy consumption, so as to prolong the supply of nonrenewable energy resources and provide additional time to develop alternative sources. Energy conservation is the cornerstone of President Carter's National Energy Policy for the United States. It is also inherent in all European energy planning, as stated in a recent report by the Director-General for Research, Science, and Education of the Commission of the European Communities (1979): "The assumed levels of conservation are the most significant factor in every [energy] assessment." All of these assessments "include very strong conservation measures, without which all outcomes would exceed the technical maximum." Similar policies have been proposed for several individual European countries (Meyer-Abich, 1978; Leach, 1979).

In addition to emphasizing a transition from nonrenewable to renewable energy sources, conservation can be viewed as a highly desirable permanent energy policy. It is often said that energy conservation is our most important energy source (Meyer-Abich, 1978). Energy wasted is energy lost, regardless of its source, and all industrial nations waste huge amounts of energy every year. The United States and Canada are by far the worst offenders, since they consume nearly twice as much energy per capita or per dollar of gross domestic product as any other industrial nation (Schipper and Lichtenberg, 1976; Darmstadter, et al., 1977). Numerous analysts have concluded that between 30% and 40% of all energy consumed in the United States is wasted (Sawhill, 1974; Schipper and Lichtenberg, 1976), and much of this could presumably be prevented by effective conservation programs (Cole, 1975; Skidmore, Owings, and Merrill, 1976). And despite much lower levels of energy consumption in all European countries, it has recently been estimated that conservation could reduce future European energy requirements by over 25% (Meyer-Abich, 1978; Directorate-General for Research, Science and Education, 1979). Moreover, energy conservation costs only one-half to one-fourth as much as new energy production (Lovins, 1977; Schneider, 1978). Hence there are quite sufficient grounds, apart from the current energy crisis, for promoting energy conservation as a vital policy in all industrial societies.

Energy conservation is particularly critical for consumers, for two reasons: (1) Between 30% and 50% of all direct energy consumption in most industrial societies occurs in the domestic sector.[1] (2) Most efforts by industry, business, and the public sector to conserve energy will have far-reaching consequences for consumers. The focus of this paper is therefore on individuals and households as the final consumers of energy. This domestic consumption sector includes both energy used in the home and for personal transportation.

Meaning of Consumer Energy Conservation

The basic goal of all energy conservation policies is to reduce the consumption of energy from nonrenewable sources. This goal can be conceptualized in four different ways, although many writers have utilized only one or two of these limited perspectives on energy conservation. We shall treat them as four alternative approaches to the overall policy goal of reducing energy consumption from nonrenewable sources. They are:

1. Technical efficiency. Make current technical equipment more efficient, so that less energy is required to perform the same functions (e.g., have the furnace cleaned and serviced).

2. Alternative sources. Change from a non-renewable to a renewable energy source (e.g., install a solar heating system).

3. Behavior changes. Use technical equipment more efficiently, so that less energy is needed to maintain one's present lifestyle (e.g., turn down the heating temperature at night).

4. Lifestyle modifications. Adopt new patterns of consumption and living that require less total use of energy (e.g., move from a single-family to a multi-family dwelling).

All four of these approaches to conservation involve both technical and human factors, although the first two are more directly oriented toward technical actions, while the latter two are aimed primarily at human aspects of energy use. Looked at differently, the first three approaches assume no intentional changes in consumer values and goals, whereas such changes are central to the fourth approach -- although lifestyle modifications can range from minor alterations (such as walking more) to totally new living patterns (such as low-consumption self-sufficiency). While these approaches therefore differ significantly in emphasis, they should not be viewed as incompatible or mutually exclusive, so that a comprehensive energy conservation policy might incorporate all four of them.

Areas of Domestic Energy Consumption

Most energy consumption by individuals and households can be divided into three broad categories of direct use, plus indirect consumption of the energy used in the production of all goods. Direct use is estimated to constitute about 60% of all domestic energy consumption in the U.S., while indirect consumption is about 40% (Hayes, 1976).[2] The three principal areas of direct domestic use are as follows (Newman and Day, 1975:34):

1. Space conditioning: heating and air conditioning (32% of all direct domestic use in the U.S.).

2. Appliance use: water heating, cooking, refrigeration,

lighting, and all other appliances (24% of all direct domestic use in the U.S.).

3. Private travel: automobiles, taxies, buses, and airplanes (44% of all direct domestic use in the U.S.).

(Some writers treat water heating as a separate category from other appliances, but combining them emphasizes the fact that the amount of energy used by all other appliances is quite small in comparison with water heaters.)

Need for Social Research on Consumer Energy Conservation

Much of the existing research and writing on energy conservation has dealt principally with the technical aspects of energy consumption and demand (BMFT, 1978; Cook, 1976; Fichtner, 1978; Skidmore, Owings, and Merrill, 1976). Most of the conservation proposals in this literature, consequently, consist of technological ideas for obtaining, transmitting, and using energy more efficiently. Without doubt, more efficient technology can greatly reduce energy waste. Regardless of whether technological innovation is as simple as putting insulating covers on hot water heaters, or as complex as developing more fuel-efficient autos, it must be a fundamental aspect of any energy conservation policy. Energy consumption is a technical process, and the more efficient that process can be made, the less energy it will require.

We quickly encounter serious problems, however, if we assume that a "technical fix" approach is adequate, by itself, to achieve significant energy conservation. Technology is worthless unless it is used by people, which means that they must be willing to adopt and utilize it in an appropriate manner. Consequently, promoting energy conservation is ultimately as much a human as a technical problem. In fact, a variety of highly effective conservation technologies are already available. What we don't know very much about is how to induce people to adopt and use these conservation technologies (O'Toole, 1976). This problem of discovering how to encourage people to practice energy conservation clearly calls for contributions from all the social sciences, including sociology, psychology, economics, political science, jurisprudence, and public administration. Because of our concern in this paper with consumer behavior, however, we shall draw primarily on work by sociologists and social psychologists.

When social scientists have examined the problem of energy conservation, they have frequently taken a broad-scale or macro perspective, dealing with such topics as the effect of conservation on national economic growth and industrial productivity (Energy Policy Project, 1974; Hudson and Jorgenson, 1974), projected future energy consumption trends (CONAES, 1978; Hirst and Carney, 1978), or scenarios of possible future societies (Harman, 1977; Lovins, 1977; CONAES, 1977). In contrast, relatively little attention has been given by social scientists to the question of how to achieve greater energy conservation. Ian Forbes (1977) makes this point quite forcefully in a rebuttal to Amory Lovins' idea of "soft energy paths": "It is this question of 'how' that is so fundamental to decision-making in general, and energy in particular, yet it is absent from many current deliberations in all but the most simplistic sense."

A Theoretical Perspective on Energy Conservation

The problem of promoting consumer energy conservation can be viewed theoretically as a particular instance of the general process of creating intentional social change. Although social scientists have constructed conceptual models of this overall process (R. Warren, 1977), they have not thus far developed a theoretical framework with which to examine the implementation of energy conservation. A suggestive perspective on this topic is provided, however, by Garrett Hardin's (1968) parable of the "tragedy of the commons," which emphasizes the continual conflict between immediate private interests and long-term public concerns. As described by Stern (1976):

> Time is running out for the world. Overpopulation, pollution, and the depletion of nonrenewable resources are the result of uncontrolled growth in a finite environment. These processes are the product of a pervasive conflict between the individual short-term good, which

> demands continual growth, and the collective long-term good, which requires restraint. Garrett Hardin...compares our situation to that of a group of herdsmen grazing their cattle on a common range. Each is motivated to add an animal to his or her herd since the net profit will be the full value of an animal less a small cost due to competition from the new animal for the available grass. Since each herdsman will profit from adding animals, there is and inexorable trend toward overgrazing of the range, which ends only with the ruin of all the shepherds. Hardin argues that the logic of the commons operates whenever people have unlimited access to a cheap but finite resource.... The logic of the commons dictates that, through the rational actions of individuals pursuing their own well-being, these resources will all be exploited until they can no longer support the population. This situation is called tragic because individual rationality leads with certainty to collective ruin.

The basic point of Hardin's parable is that when a desired public good exists in finite quantities, eventual collective disaster can be avoided only if everyone limits their concern with maximizing short-term benefits. In other words, the "challenge of the commons" is to discover how to intentionally change human behavior and society toward the goal of balancing or integrating private expediency with public responsibility. An alternative way of stating this same problem is to ask how people can be induced to each contribute their individual share to the attainment of a public good that will benefit everyone (Olson, 1965). Successful implementation of any large-scale energy conservation program may well depend on finding a viable solution to this twentieth-century version of the "public goods dilemma" that appears to be leading inexorably to a "tragedy of the energy commons."

It is critical, however, that we not misinterpret Hardin's parable. He is not suggesting that all personal interests be surrendured to the service of the public good. He is arguing, rather, that some kind of limit must be placed on the unbridled pursuit of private gain, so that collective goals can also be realized. Such restraint can always be imposed on individuals by outside forces such as government or the marketplace. Alternatively, however, individuals can voluntarily control their own behavior for the sake of the common good. In this analysis of consumer energy conservation policies, we assume that both voluntary and involuntary strategies will be necessary, but that both approaches can be integrated into coherent public policies to attain the goal of reducing the consumption of nonrenewable energy.

Previous Social Research on Consumer Energy Conservation

Since the 1974 oil embargo, well over two hundred empirical studies of consumer energy conservation have been conducted by social scientists, mainly in the United States. Economists have reexamined the effects of price changes on energy consumption, social psychologists have done experiments on the effects of information and incentives on people's conservation attitudes and actions, sociologists have conducted surveys to discover how extensively conservation practices have been adopted by the public, and political scientists have explored possibilities for governmental conservation programs. Many of these studies are summarized and critiqued in six recent works, which together provide a fairly comprehensive overview of recent social research on energy conservation: Cunningham and Lopreato, 1977; Ellis and Gaskell, 1978; Milstein, 1977; Olsen and Goodnight, 1977; Warkov, 1978; and Winett and Neale, 1978. (With the exception of Ellis and Gaskell, no such overviews have been compiled of European research on energy conservation.)

The principal findings of all this research can be illustrated by the following typical generalizations:

1. Most people understand that there is an energy problem, and between one-third and one-half of them view it as serious, either now or in the future.

2. There is no relationship between belief in the seriousness of the energy problem and taking any conservation actions.

3. Knowledge of energy conserving techniques is not sufficient, by itself, to motivate people to take conservation actions.

4. Intensive consumption-feedback and financial-incentive programs can reduce domestic energy consumption by 10% to 20%, at least for a short period.

5. A majority of households have taken some minimal conservation actions such as turning off unused lights.

6. People are just starting to take major conservation actions such as adding insulation to their homes.

7. When asked why they are taking conservation actions, people give primarily two answers, with approximately equal frequency: (a) to save money, either now or in the future; and (b) to make a contribution to solving the energy crisis.

8. Rising energy prices, as experienced thus far, affect people differently, according to their income level: (a) low-income people have little discretion for reducing energy use, and hence merely suffer further financial hardships; (b) middle-income people do respond to price increases by attempting to reduce their energy consumption; (3) high-income people make no more than token conservation gestures and largely continue to consume as much energy as ever.

9. Large majorities of the public would like the government to take rather strong actions to promote energy conservation in an equitable manner, including setting energy efficiency standards for buildings and products, giving financial subsidies for investment in home conservation improvements, establishing zoning and land-use requirements to promote conservation, and operating energy allocation programs.

10. At the same time, the less disruptive a proposed energy conservation program would be to people's current lifestyles, the more widely and quickly it will likely be adopted.

These generalizations provide considerable useful information about current energy conservation efforts, but they also display numerous deficiencies in our knowledge. In particular, there is presently an almost total lack of policy-oriented social research that might assist public policy makers and governmental officials in designing and implementing effective energy conservation policies. "Not very much is known about consumer reactions to conservation incentives -- whether they be price, low-interest loan, or tax rebates.... It is not even known whether public policies designed to promote energy efficiency or to reduce consumption will influence the consumer at all" (Cunningham and Lopreato, 1977:77).

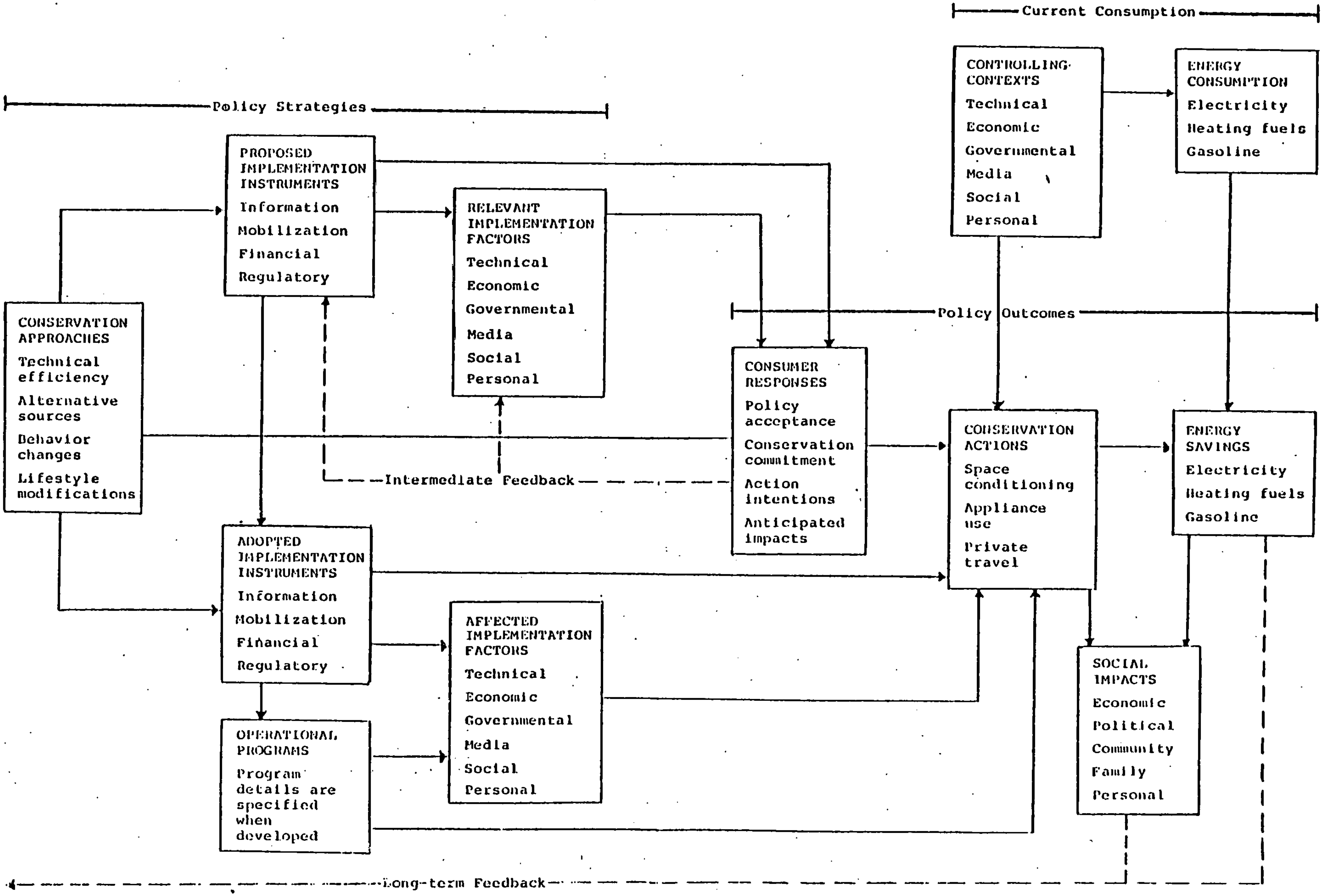
The Process of Promoting Consumer Energy Conservation

Our principal concern in this paper is to develop an analytical framework for social science research on consumer energy conservation policies. More specifically, we are concerned with strategies that governments -- federal, state, and local -- can use to promote greater energy conservation among consumers. Figure 1 presents a model of the overall process of promoting consumer energy conservation, as we conceptualize it. This model provides a schematic overview of the framework that will be developed in the following sections of the paper.

The model contains three main parts. In the top right-hand corner is "Current Consumption." It consists of two boxes: (1) Controlling Contexts (technical, economic, governmental, media, social, and personal) that shape consumer energy consumption; and (2) current Energy Consumption (of electricity, heating fuels, and gasoline). At the left side of the model is "Policy Strategies." It contains six boxes representing the principal aspects of any strategy for promoting intentional social change: (1) the previously mentioned Conservation Approaches (technical efficiency, alternative sources, behavior changes, and lifestyle modifications); (2) Proposed Implementation Instruments, or possible procedures for attaining policy goals (information, mobilization, financial, and regulatory); (3) the Relevant Implementation Factors that presumably would be affected or engaged by those instruments (technical, economic, governmental, media, social, and personal); (4) Adopted Implementation Instruments that are actually utilized by a government; (5) the Operational Programs developed to carry out those instruments; and (6) the Altered Implementation Factors that are actually changed or engaged by the instruments and programs that are enacted. In the lower right-hand corner of the model is "Policy Outcomes." The four boxes here depict the various kinds of results that policy strategies might produce, in conjunction with the current controlling contexts and energy consumption levels: (1) Consumer Responses, or verbal reactions by consumers to proposed strategies (policy acceptance, conservation commitment, action intentions, and anticipated impacts); (2) Conservation Actions that are actually taken by consumers (concerning space conditioning, appliance use, and private travel); (3) the Energy Savings that result from those actions; and (4) the Social Impacts produced by the conservation actions and energy savings.

Figure 1.

THE PROCESS OF PROMOTING CONSUMER ENERGY CONSERVATION



II. THE CONTEXTS OF DOMESTIC ENERGY CONSUMPTION

If we are to successfully change the way in which people use energy, we must first understand both (1) their present patterns of energy consumption, and (2) the conditions or contexts that shape those consumption patterns. Consumer energy use patterns have been fairly well documented for the United States (Newman and Day, 1975; Perlman and Warren, 1977), and similar research has been conducted in Germany (Joerges and Kiene, 1979; Stanford Research Institute, 1975), Sweden (Doernberg, 1975; Schipper and Lichtenberg, 1976), and several other European countries (Darmstadter, et al., 1977). In constrast, little attention has been given thus far to the contexts that largely determine how and to what extent consumers use energy. This section therefore focuses on these controlling contexts and some prerequisites for changing them in order to conserve energy.

Current patterns of energy consumption are the joint product of (1) the technical characteristics of the material equipment involved in producing, distributing, and consuming energy; (2) the institutional characteristics of relevant economic, governmental, media, and social structures; and (3) relevant personal characteristics of individual consumers. Changes in energy consumption, whether desirable or undesirable, will always be a consequence of changes in some or all of these controlling contexts. Changes in one context will, as a rule, produce frictions and conflicts in the other contexts, necessitating complex adaptations before consumption patterns become stabilized on a new level. Any policy for promoting energy conservation -- whether its main thrust is technical, institutional, or personal -- must therefore be based on an understanding of the ways in which all of these interactive contexts shape energy consumption.

Whereas numerous energy conservation studies have examined the technical factors affecting energy consumption, little research has been done on the ways in which this technical context is integrated into institutional and personal systems (for one attempt to do so, see Joerges and Kiene, 1979), the nature of those other contexts, or the relationships among them.

Technical Context

The technical characteristics of people's living conditions will directly affect the amount of energy they consume, regardless of individual variations in energy use habits. The major features of this technical context of domestic energy use are these:

1. Dwelling unit: its size, construction, insulation, and other thermal properties.
2. Energy consuming equipment in the dwelling unit: type, fuel used, and functional efficiency of the heating unit, hot water heater, and other major household appliances (stove, refrigerator, freezer, dishwasher, washing machine, and dryer).
3. Personal transportation equipment: type and functional efficiency of automobiles, recreational vehicles, and motorcycles.
4. Public transport system: type, fuels used, and its functional efficiency.
5. Community design: relevant characteristics of the physical infra-structure of the community for work, shopping, education, recreation, and transportation (such as density, relative location of facilities, and micro-climatic conditions).

Some of these technical factors are subject to consumer choice, while others are not, either because the market does not provide consumers with alternatives, or because alternatives are out of the legal or economic reach of individual consumers. Important characteristics of the technical context which can be manipulated directly by consumers include: (a) insulation in the attic; (b) air leaks around windows and doors; (c) operating condition and insulation of the heating unit; (d) size and fuel efficiency of other major household appliances (within the limits of available products); (e) thermostats and other metering and regulating devices for energy consuming equipment (again within the limits of available instruments);

and (f) the size of one's car. Technical characteristics that cannot easily be altered by the average consumer include: (g) the size, construction, and location of one's home; (h) the physical design of the community; (i) facilities for public transportation; and (j) new fuels and their associated technologies (e.g., solar collectors, photovoltaic cells, and methonal autos) that are not yet commercially available.[3]

As recently discussed by Harwood (1977) and several other writers, total energy consumption in a community is heavily influenced by numerous features of its physical design and properties. Particularly crucial in this respect have been the pervasive urban trends toward single-family dwellings; suburbanization and urban sprawl; separation of work, residences, consumption, and recreation; increasing reliance on private automobiles; and neglect of mass transit systems. Comprehensive community planning and redesign to make buildings, land-use patterns, and transportation networks more energy efficient offers many new and fascinating possibilities for conserving energy. This endeavor may be seriously limited, however, by the fact that the social integration of complex technical aggregates such as whole cities is not well understood by the social sciences (Joerges, 1977 and 1979).

For each area of energy consumption (space conditioning, hot water heating, and private travel), one can then ask whether or not (1) current energy consuming technology is economically feasible; (2) if so, whether or not it is legally and economically available to individual consumers; and (3) if so, whether or not it is actually used by them. Depending on the answers to these questions, the analyst will then look for factors affecting energy consumption in the economic, governmental, media, social, and personal contexts.

Economic Context

Energy consumption is a complex economic activity involving as a rule the purchase and combined use of numerous goods and services, from both public and private companies, over an extended time period. Apart from level of income and ownership of goods, which will be treated as personal properties, these complex economic aspects of domestic energy consumption are shaped by such factors as:

1. Energy rates: In what ways do current energy prices and rate structures (declining, constant, or increasing with the amount used) explain people's energy choices and consumption levels?[5]

2. Billing procedures: Do procedures for energy billing (such as metering the amount actually used, charging according to the size of the dwelling unit, the time schedule of the billing, information contained in the bill, or gasoline credit cards) affect energy consciousness, willingness to pay for various kinds of energy, and amount consumed?

3. Energy and product availability: Are technically and economically satisfactory kinds of energy and energy-consuming equipment made available to consumers? To what extent do energy and utility companies control energy price and availability monopolistically? Is the availability of energy and energy equipment affected by the economic resources and willingness to pay of consumers?

Again, some economic factors -- such as the structure of energy and utility companies, or the functioning of the energy economy as a whole -- are relatively impervious to change initiated by consumers. These factors are influenced primarily by long-term government and business action. Industry and government will, however, be sensitive to the general consciousness and sensitivities of the consuming public in energy matters.

Other features of the economic context can be manipulated more readily by individual consumers and organized consumer groups. These include, at least to a certain extent: (a) prices and rates for various forms of energy; (b) types of metering and billing; (c) types of energy consuming appliances; and (d) relevant consumer information provided by producers and sellers of energy and energy-consuming equipment.

Government Context

Government agencies exercise considerable control over both the technical and economic contexts of people's energy use. This is especially the case when public utilities are operated by the government. In that situation, governmental action influences domestic energy consumption as directly as the economic factors mentioned previously, although consumer/governmental relations pose problems distinct from those encountered by consumers in the private market (Young, 1978). In other cases, government influence will be less direct, since it will be mediated by the economic and technical contexts, but it can nevertheless be quite pervasive. Important features of the governmental context are these:

1. Regulations governing energy companies and utilities: price determination (fixed prices, price ceilings, or procedures for setting prices), investment credits and depletion allowances, monopoly controls, and operating requirements.

2. Standards for equipment efficiency and equipment information: building standards, appliance standards, and automobile standards, as well as regulation of advertising and product labelling.

3. Research and development for alternative technologies: legal and financial measures to encourage the introduction of innovative products and processes in household and transportation technology.

4. Community codes: zoning laws, building requirements, landlord-tenant contracts, and liability rules.

5. Consumer policy: relevant consumer information and protection provided by public agencies.

6. Governmental officials: their public stance toward energy conservation and leadership in promoting it.

Many of the factors comprising this context can be manipulated easily if government wishes or is under public pressure to do so. These include: (a) regulations and operating requirements for existing utilities; (b) standards for relevant equipment and materials available in the market; and (c) advertising and labelling requirements. Other factors -- such as (d) investment planning in energy production; (e) building, zoning, and rent laws; and (f) energy research and development in industry -- are in principle subject to governmental action, but cannot readily be influenced by the agencies responsible for conservation policy. Considerable debate over which governmental agency has the authority to take these kinds of actions regularly occurs whenever conservation interests conflict with other interests. This applies to both horizontal linkages (i.e., between departments) and to vertical linkages (i.e., between federal, state, and local governments).

Media Context

Part of the information that influences people's decisions about energy consumption is channelled through the mass media. This is obviously the case with product advertising by private businesses, and with government sponsored information about the energy situation and energy policy. In addition, the various media may or may not give special attention to energy issues from the consumer's point of vies.

The context of mass media communication is very broad, encompassing television, radio, newspapers, magazines, books, and movies, as well as the "new media" of computer-based telecommunication. Its main features are:

1. Editorial content: information about the energy situation and energy conservation generated by the media themselves, as well as the audiences reached by these messages.
2. Product advertising: the extent, content, and effectiveness of advertising by businesses for energy consuming products and energy uses.
3. Image advertising: the extent and content of "advocate" advertising by industry, utilities, and government stressing their point of view on energy issues and responsibilities.
4. Consumption and conservation literature: the availability, content, and distribution of commercial literature on energy consumption patterns and conservation practices.

With all these factors, a distinction must be made between the transmission and reception of information. The fact that conservation information is transmitted to the public through the mass media does not ensure that it will effectively reach its intended audiences. The extent to which energy consumption is actually shaped by the media context depends largely on the manner in which information is geared to personal factors such as people's concern with, and knowledge about, energy matters, as well as their informal communication networks for disseminating media information.

Although information alone rarely changes behavior, the mass media perform pervasive supporting and legitimating functions for all kinds of social behavior. Presumably, therefore, the media do influence energy consumption patterns, and can affect attempts to change those patterns to socially accepted new levels (either up or down). The role played by the media in this process is not clear, however. On the one hand, the media are the main channel through which businesses and utilities disseminate information designed to deemphasize conservation issues (Battelle, 1977; Sethi, 1978), while neither consumers nor government can easily influence the structure or messages of the media. On the other hand, the press and television have generally taken a rather "progressive" stand on energy conservation, and attempts have been made with some success to market ecological products through the mass media (van Raaij, 1978).

Social Context

Energy-related behavior is, within the limits set by available technology, as much affected by interpersonal influence and mutual support as by media information, governmental regulations, and economic conditions. This context of social influence outside the media, government, and the economy must therefore be regarded as another set of critical factors affecting energy consumption. It includes:

1. Interpersonal interaction: interaction with friends and neighbors on a regular basis, and group expectations concerning energy use, conservation efforts, and ownership of energy consuming products.

2. Neighborhood activities: existence, visibility, and effectiveness of neighborhood-level activities designed to affect energy consumption or conservation.

3. Organizational actions: membership and participation in relevant interest organizations such as consumer and environmental associations that actively promote energy consumption or conservation, or that indirectly support either the consumption or conservation of energy through their actions.

4. Community programs: existence, visibility, and effectiveness of community-level programs designed to affect energy consumption or conservation.

Two conflicting principles operate in this context. On the one hand, the closer and more personal a social setting is for an individual, the more influence it is likely to exert on him or her. This suggests that interpersonal interaction should be very effective in promoting energy conservation. On the other hand, the more highly organized and centralized a social setting, the more easily it can be redesigned to encourage social change. This suggests that interest organizations and communities should be more effective in promoting conservation. The major consideration in this context, therefore, is the nature and viability of social linkages between large organizations and more informal social relationships. If these linkages are numerous and strong, changes can be introduced at a broad level, and will then be transmitted outward to neighborhoods and small groups where most individuals will encounter them.

The social context of energy consumption is also the setting for two opposing social forces. The social inertia of established tradition and deeply engraved customs often acts as a barrier to technical and economic changes that would conserve energy. At the same time, the social context provides a dynamic field in which new social movements arise and alternative solutions to economic and technical problems make their first appearance before being accepted within the economic and governmental contexts (Rammstedt, 1979).

Personal Context

Energy consumption is always mediated by numerous personal factors. In the last analysis, it is the individual consumer who acquires and uses energy-consuming equipment, and who either consents to current energy conditions or seeks to alter energy consumption patterns by demanding appropriate changes in other controlling contexts. In theory, the personal context is composed of two parts: (1) the "inner" behavioral dispositions acquired through socialization in the past, which mirror earlier states of the other controlling contexts; and (2) the current states of the other contexts as perceived and experienced by the individual. We also include in this context the sociodemographic and socioeconomic characteristics of consumers. Without strictly differentiating between "inner" dispositions and experiences of "outer" situations, the vast array of personal factors affecting energy consumption can be reduced to the following components:

1. Basic value orientations: people's values concerning technological development, economic growth, material consumption, socioeconomic status, quality of life, environmental protection, and resource conservation.

2. Perceptions of the energy situation: whether or not an energy problem is perceived (either at present or in the future), the perceived seriousness and immanence of this problem, its probable causes and consequences, and the people and groups to whom responsibilites are attributed.

3. Energy consumption knowledge and understanding of technical energy systems: knowledge of present energy patterns and levels, of energy-using equipment, and of possible means and procedures for reducing energy consumption.

4. Energy conservation experience: the nature, extent, and recency of a person's past experience with energy conservation efforts.

5. Sociodemographic and socioeconomic characteristics: age, sex, race, family compostion, education, occupation, and income.

It has been argued that basic value orientations in industrial societies are undergoing remarkable changes, although it is not clear whether these changes are essentially a class phenomenon or whether they are typical of particular stages of technological and economic development (Inglehart, 1977). Meanwhile, although perceptions of the reality and seriousness of the energy problem are expanding in some countries and may affect energy consumption in subtle ways (Battelle, 1977; Milstein, 1977; Yimmermann, 1978), a direct relationship beween such perceptions and energy-related behavior has not been demonstrated (Honnold and Nelson, 1976). More seriously, knowledge of one's own energy use and levels of competence in dealing with technical energy systems are quite low among many people (Clemens, 1978; Molt, 1978; Newman and Day, 1975). Previous personal experience with energy conserving practices does appear to increase one's receptivity to new conservation measures, however (Curtin, 1975).

Focus on the Consumer

The argument was made in Section I that energy conservation can be viewed as a "commons" or "public goods" problem that might be approached from a macro or structural perspective or from a micro or individual perspective. Much previous writing on energy conservation has been limited to one of these twin perspectives. On the structural side, engineers have commonly studied total energy systems, while macro-economists have explored national or international economic marketplaces (see Hoffman and Jorgenson, 1977, for a discussion of these structural approaches). On the individual side, psychologists have focused on internal psychological states as determinants of energy consumption, while micro-economists have treated individuals solely as rational economic actors.

Our intention in this analysis is to bridge that macro-micro gap by focusing on consumers as active decision makers who continually respond to both external structural forces and internal personal conditions. We do not attempt to construct a "total system model" encompassing every variable that might conceivably affect energy consumption. Instead, we examine all of the contexts that influence energy consumption -- technical, economic, governmental, media, social, and personal -- looking for those factors that are most critical in shaping the actions of energy consumers. We ask how all of these relevant factors interact with one another, and how the consumer responds to them in terms of either consuming or conserving energy. In short, we focus on the energy consumer as an active decision maker who acts within the complex setting provided by technical, institutional, and personal contexts.

III. STRATEGIES FOR PROMOTING CONSUMER ENERGY CONSERVATION

The primary concern of this paper is with the strategies that governments can use to promote energy conservation among consumers. A policy strategy is a procedure designed to attain a broad policy goal such as energy conservation or zero energy growth. In other words, a strategy is a plan for enacting a public policy. As was shown in Figure 1, we conceive of strategies as composed of six major components: (1) alternative approaches to the goal of conserving energy; (2) proposed instruments for implementing a conservation policy; (3) factors in the controlling contexts that are expected to be affected or engaged by the proposed policies; (4) the implementation instruments that are actually adopted; (5) the specific programs that are developed to carry out those adopted instruments; and (6) the portions of the controlling contexts that are actually altered or engaged by the enacted instruments and programs. This section examines these components of policy strategies in greater detail, under three headings: (1) Conservation Approaches; (2) Implementation Instruments (both proposed and adopted); and (3) Implementation Factors (both relevant and affected). Specific conservation programs are not discussed, for reasons given below.

Conservation Approaches

As mentioned in Section I, the overall goal of reducing the consumption of nonrenewable energy can be approached in four different ways: (1) making current technical equipment and processes more energy efficient; (2) changing from nonrenewable to renewable energy sources and technologies; (3) using technical equipment more effectively; and (4) adopting new patterns of living that require less energy consumption. In addition, three major areas of domestic energy consumption were identified: (1) space conditioning, (2) appliance use, and (3) private travel.

Combining these four approaches with the three consumption areas produces a twelve-cell matrix, as shown in Figure 2. Within each cell of this matrix we can identify particular actions that might be taken by individuals or households to reduce their energy consumption. The full range of possible consumer energy conservation actions is virtually limitless, but the energy savings that can be realized from most of those actions -- such as turning off lights -- are relatively trivial. Such actions may serve as symbols of one's concern with conservation, they may socialize people to be more energy conscious, or they may give one a feeling that he or she is contributing to the conservation effort. They do not, however, save large amounts of energy. A carefully planned conservation policy, consequently, might emphasize primarily those actions -- such as the ones listed in Figure 2 -- that do result in substantial energy savings.

Implementation Instruments

To attain a policy goal such as consumer energy conservation, governments must select and utilize various implementation instruments. These can be thought of as alternative means of intentionally creating social change, and hence are the dynamic heart of any policy strategy. In Figure 1, these implementation instruments were divided into two sets: proposed and adopted. The first set consists of all those instruments that are considered by a government and proposed to the public. On the basis of the responses to these proposals that are received from the public, interested organizations, and other governmental agencies, parliaments and governmental agencies will adopt some (or all) of those instruments as procedures for attaining the overall policy goal. This discussion of implementation instruments treats both sets together, since the instruments are the same in both cases.

In this paper we discuss only implementation instruments, and ignore specific operational programs, for two reasons:

Figure 2

IMPORTANT CONSUMER ENERGY CONSERVATION ACTIONS?
ARRANGED BY CONSERVATION APPROACHES AND AREAS OF CONSUMPTION

Conservation Approaches	Areas of Consumption		
	Space Conditioning	Appliance Use	Personal Transportation
Technical Efficiency	Add insulation to the dwelling unit	Insulate the hot water heater	Drive a small, fuel-efficient auto
Alternative Source	Install a solar. heating system (active or passive)	Install a solar hot water heater	Use methonal as an auto fuel when available
Behavior Change	Lower the heating temperature	Lower the hot water temperature	Travel by mass transit or carpool
Lifestyle Modification	Live in multifamily housing	Share use of appliances	Live close to one's employment

(1) Many public officials and energy experts often jump immediately from the broad goal of conserving energy to designing specific conservation programs, giving little or no thought to the kinds of instruments that might be most effective in pursuing their goal and that will intentionally or unintentionally shape their programs. We contend that giving careful attention to alternative implementation instruments is a crucial -- perhaps the crucial -- aspect of developing strategies for promoting social change. (2) Since programs must always be tailored to fit the particular situations in which they are conducted, they tend to differ widely across places and times. In contrast, instruments can be analyzed in general terms without reference to particular settings.

Instruments for implementing social change can be grouped into four broad categories.[5] Information instruments are based on cognitive and attitudinal theories of social change. These instruments communicate information to people in order to make them aware of a problem and the actions they can take to help alleviate that problem, and also to change people's attitudes and values so that they will want to take those actions. Mobilization instruments are based on social interaction and influence theories of social change. These instruments involve people in social activities in which they will be influenced by others or can act collectively to attain common goals. Financial instruments are based on economic and behavioral theories of social change. These instruments provide monetary inducements or deprivations to people that will make it rationally expedient for them to change their behavior. Regulatory instruments are based on social structural and power theories of social change. These instruments employ political power to alter the social environments in which people live, so that individuals will change their actions in response to these new conditions or be sanctioned for not doing so.

Figure 3 lists three different implementation instruments falling within each of the above four categories. The following paragraphs comment on each of these twelve instruments in some detail.

Problem awareness. This instrument informs people about known fuel availability, energy use patterns , future energy projections, and other aspects of the energy problem. The hope is that if people truly understand the extent and seriousness of the global energy crisis, they will voluntarily begin conserving energy. With only a few exceptions, however, all of the research conducted thus far as found little or no relationship between belief in the reality of the energy problem and any actual energy conserving actions (Cunningham and Lopreato, 1977; Gottlieb and Matre, 1976; Honnold and Nelson, 1976;Perlman and Warren, 1977; Stern, 1976; D.Warren, 1974). Consequently, modifying an individual's attitudes does not appear to be a necessary first step in promoting energy conservation (Heberlein, 1975). However, increased understanding of the energy problem does appear to make people more receptive to the use of other implementation instruments (Zuiches, 1976), so that public education efforts may lay a valuable groundwork for energy conservation by creating a climate of favorable public opinion.

Conservation techniques. This instrument informs people about actions they can take to reduce their consumption of nonrenewable energy, and about the possible energy and monetary savings of these actions. Such information is certainly necessary if people are to conserve energy, since without it they will have no idea of how to reduce their energy consumption. At the same time, there is fairly general agreement that this kind of information, by itself, is not sufficient to motivate conservation behavior (Ellis and Gaskell, 1978; Hayes and Cone, 1977; Milstein, 1977; Palmer, Lloyd, and Lloyd, 1978; Winett, et.al., 1978). For example, a recent field experiment found that neither (1) attending a block workshop at which conservation techniques were described, nor (2) having a home energy audit, significantly improved

Figure 3.

ENERGY CONSERVATION IMPLEMENTATION INSTRUMENTS

Information Instruments

1. Problem awareness: Informing people about the nature and seriousness of the energy problem.

2. Conservation techniques: Informing people about actions they can take to reduce domestic energy consumption.

3. Consumption feedback: Giving people frequent feedback on their current level of energy consumption.

Mobilization Instruments

4. Neighborhood activities: Conducting neighborhood-level energy conservation activities such as block workshops.

5. Organizational actions: Encouraging existing interest organizations to promote energy conservation in their actions.

6. Community programs: Organizing community-wide energy conservation programs of various kinds.

Financial Instruments

7. Monetary incentives: Offering monetary benefits or imposing monetary penalities to encourage energy conserving actions.

8. Price increases: Allowing or forcing energy prices to rise so as to encourage reduced energy consumption.

9. Energy surtax: Imposing a surcharge on all purchases of non-renewable energy, with revenues redistributed to all citizens.

Regulatory Instruments

10. Energy standards: Setting and enforcing required energy efficiency standards for all energy-consuming products.

11. Energy allocation: Establishing energy consumption quotas or otherwise rationing the consumption of energy.

12. Community design: Uusing planning, zoning, and other legal actions to reconstruct community land use and building design.

people's knowledge of how to save energy in the home (Olsen and Cluett, 1979). In sum: "the current conclusion is that 'information alone does not work'" (Winett and Neale, 1978).

Consumption feedback. This instrument gives consumers frequent or continual feedback on their current energy consumption, and compares the current level with a preselected goal. The presumption is that if people can be made aware whenever they are using too much energy -- in relation to either an ideal standard or a goal they have set for themselves -- they will take action to reduce their energy use. This feedback process has been studied in a large number of field experiments of electricity consumption, with contradictory results.[6] Some of these experiments have reduced electricity consumption from 10% to 20%, especially when consumers set demanding goals for themselves (McClelland and Cook, 1978; Palmer, Lloyd, and Lloyd, 1977; Seligman, Darley, and Becker, 1977-78). In contrast, a number of other studies have found that when consumption feedback is combined with financial incentives for conservation, only the latter instrument reduces consumption significantly, while feedback by itself produces no energy savings (Hayes and Cone, 1977; Kohlenberg, et.al., 1978; Winett, et.al., 1978). There is no doubt that feedback will make people more aware of how they are using energy, but there is serious doubt among many researchers that feedback, by itself, is sufficient to motivate people to take conservation actions (Ellis and Gaskell, 1978).

Neighborhood activities. This instrument conducts conservation activities and programs within local neighborhoods, so that people will have direct personal exposure to them, while also experiencing interpersonal influences from their neighbors to adope energy saving practices. These activities might include informal meetings among friends, neighborhood-level workshops, and energy conservation educational programs be the local schools. (The latter efforts might be particularly effective when schools are viewed as "community schools" that serve the entire population of a neighborhood.) The impetus for this approach came from a study of responses to the 1974 oil crisis, which discovered that a major factor determining whether or not people in the U.S. took any conservation actions was the extent to which their neighbors were making such efforts (D. Warren, 1974). More recently, the program of block-level conservation workshops mentioned above did produce a significant increase in conservation actions among those who attended (Olsen and Cluett, 1979). Neighborhoods thus appear to offer potentially effective settings for energy conservation activities.

Organizational actions. This instrument utilizes existing special-interest associations of all kinds as vehicles for promoting energy conservation. Numerous studies have found that organizational membership and participation can strongly influence people's attitudes and actions (Verba and Nie, 1972). Consequently, if such organizations were to stress energy conservation in their programs and actions, their members might be stimulated to begin practicing conservation in their personal lives. In addition, such organizations can also exert considerable influence on nonmembers and the public as a whole. Particularly important here are consumer organizations that actively work for energy conservation (illustrated by Verbraucher-Zentrale, 1978), although this trend is not yet very extensive (Holten, 1978). Environmental organizations have also been active in regard to energy, but have not yet given much attention to consumers.

Community programs. This instrument utilizes the entire community as a setting for encouraging energy conservation. The rationale is the same as with neighborhoods and interest organizations, but in this case the program is sponsored and coordinated by an agency of the city government. The program often includes a variety of activities aimed at different kinds of people in different situations, so that as many people as possible are exposed to the program. Few communities have yet undertaken such extensive conservation efforts, but those that have -- such as Davis, California -- report strong interest among large numbers of citizens, and overall community energy savings of 25% or more (McGregor, 1977).

Financial incentives. This instrument offers monetary benefits (such as tax deductions, tax credits, investment credits, and interest reductions) for investing in energy conserving equipment or otherwise practicing conservation. It may also impose monetary penalties (such as taxes or surcharges) on energy-consuming equipment or energy-wasting activities. The effects of incentives on energy consumption have been examined in several studies, with mixed results. In one study, cash payment incentives reduced people's automobile driving by 20% (Fox and Hake, 1976). Over 75% of the respondents in a recent survey in the United States said that the new program of the U.S. government giving tax credits for 15% of expenditures on home insulation would have "some" or "much" influence on their decision to take this action (Olsen and Cluett, 1979). Finally, several experimental studies have offered cash rebates to people who reduced their household electricity consumption. Although very large rebates (price decreases of 200% or more) produced energy reductions of up to 30%, smaller rebates (less than a 100% price decrease) had little effects on energy consumption (Hayes and Cone, 1977; Kohlenberg, et.al., 1978; Winett and Neale, 1978). Thus the use of financial incentives may prove effective in promoting energy conservation, but not enough evidence has yet been compiled to make a definite decision.

Price increases. This instrument relies on the presumed elasticity of energy consumption, which says that as energy prices rise, consumption should decline proportionally. Energy prices can be increased in either of two ways: (1) removing all non-market or political constraints, allowing prices to rise to the current world market level; and (2) imposing taxes on energy sales to raise the price above the market level. Price increases can be applied evenly to all energy sales, or they can be structured in various ways such as increasing block rates or time-of-day pricing (Doctor, et.al., 1972; Ifo, 1978; Lahmann, 1978; Luther, 1978; Skidmore, Owings, and Merrill, 1976). Numerous surveys have found that rising energy costs are the most common reason given by consumers for adopting conservation measures (Cunningham and Lopreato, 1977; Gottlieb and Matre, 1976; Milstein, 1977; Perlman and Warren, 1977). There is contradictory evidence, however. Despite sharp gasoline price increases in all Western nations after 1974, gasoline consumption has continued to rise steadily in all countries (Schneider, 1978; Willenborg and Pitts, 1977). And another study observed that: "There was no evidence that families with higher fuel prices....have lower rates of energy use per room or higher rates of conservation practice adoption" (Gladhart, et.al., 1978). Moreover, even if rising prices do reduce energy consumption, there is considerable evidence that the process does not function either equitably or very effectively. Since low-income people generally use minimally necessary amounts of energy, while spending a disproportionately large share of their budgets for energy, a price increase will only cause them severe financial problems without significantly reducing their energy consumption (Newman and Day, 1975; Morrison, 1978). High-income families, meanwhile, can afford to pay more for energy without experiencing a serious financial burden, so that rising energy prices since 1974 have not reduced energy consumption among these people, despite the fact that they use much more energy per capita than other people (Kilkeary, 1975; Walker and Draper, 1975; Morrison, 1978). As a result, only middle-income people have thus far tended to respond to rising energy prices by reducing their energy consumption (Cunningham and Lopreato, 1977; Curtin, 1975; Perlman and Warren, 1977). There are also numerous other grounds for questioning the presumed elasticity of energy consumption (Forbes, 1977; Ifo, 1978; Olsen and Goodnight, 1977), so that the effectiveness of pricing as an instrument for promoting energy conservation is open to serious doubt.

Energy surtax. This instrument is a variation on the pricing approach that is intended to eliminate the inequites of an open market and to move the economy toward more labor-intensive and less energy-intensive production. As proposed by several writers (Energy Policy Project, 1974; Hannon, 1975 and 1977; Mauch, 1978; Wilson, 1976; and Schneider, 1978), it would consist of a tax surcharge on all purchases involving nonrenewable energy sources, with the rate to vary according to current assessments of known supplies and shortages. The funds collected from this tax would be redistributed equally to all adults at the end of the year as an "energy refund". One writer (Wilson, 1976) estimated that such a tax could reduce total energy consumption in the United States by as much as 18%. At the same time, large energy users (primarily high-income people) would pay more energy taxes than their refund, while small energy users (primarily low-income people) would receive a larger refund than they had paid in energy taxes, thus providing an equitable incentive to conserve energy. Since no country has yet imposed an energy surtax with a refund, there is no empirical evidence with which to evaluate the effectiveness of this instrument at the present time.

Energy standards. This instrument requires a government to establish and enforce a variety of energy efficiency, performance, and use criteria for energy-consuming equipment. Such standards might apply to building construction, building renovation, furnaces, hot water heaters, other household appliances, and automobiles. In the United States, for instance, the Energy Policy and Conservation Act of 1975 set minimum fuel efficiency standards for all fleets of new cars beginning in 1978. Thus far, however, no nation has made very extensive use of energy standards, and there has been virtually no social science research on this instrument. Two important points about this approach can be noted, nevertheless: (1) Problems of administration, surveillance, and enforcement will undoubtedly occur and can become costly, but these costs will remain manageable as long as standards are applied to organizations rather than directly to individuals. The responsible governmental agencies can then deal directly with a relatively small number of collectivities, which can in turn incorporate the standards into their own operating procedures, so that the government need not become actively involved unless the standards are grossly violated. (2) With this macro or structural approach to enforcing standards, it is possible to retain considerable freedom of action for individuals. These "macro-constraints" (as Pirages and Ehrlich, 1974, call them) need not touch directly upon most individuals' personal lives.

Energy allocation. This instrument brings the government directly into the process of deciding how energy shall be distributed and consumed. It might set energy use quotas for various categories of consumers or various kinds of activities, or it might actually determine how much energy each consumer could use for different purposes. Allocation schemes can thus vary from broad directives to detailed rationing, but in all cases the government plays the crucial role. As with energy standards, there have been almost no empirical studies of allocation schemes for conserving energy. The two points made above concerning energy standards also apply to energy allocation, but some additional points are also relevant: (1) Rationing is widely disliked by the public, so that most people would prefer to avoid it if all possible (Keck, 1974; Milstein, 1977). (2) Rationing often hurts the poor the most. "Since their consumption is already at a very low level, the poor are hurt even more when they must cut" (Newman and Day, 1975:123). (3) Rationing programs can be extremely expensive and difficult to administer, as well as almost impossible to thoroughly enforce, unless the government permits a legal "white market" for rationing coupons as a way of preventing the growth of "black markets". This allocation approach cannot be totally dismissed, for it remains an instrument of "last resort" in times of severe energy shortage, but it is clearly not the most practical way of promoting energy conservation on a permanent basis.

Community design. This final instrument is intended to create broad-scale redesign and reconstruction of communities in order to provide more energy-conserving land-use, buildings,

Figure 4

LINKAGES BETWEEN IMPLEMENTATION INSTRUMENTS AND FACTORS

Implementation Instruments	Implementation Factors					
	Technical	Economic	Governmental	Media	Social	Personal
Problem awareness	Criticism of high energy technology	Advertising for energy conservation	Government sponsored information programs	Convey information about the energy problem	Information programs by private groups	New understanding of the energy problem
Conservation techniques	Consumer demand for conservation technologies	Consumer demand for conservation loans	Government sponsored information programs	Convey information about conservation techniques	Information programs by private groups	Increased knowledge of conservation techniques
Consumption feedback	Development of feedback meters	Reduction in cost of feedback meters	Government require feedback meters	Convey information about feedback meters	Information programs by private groups	Increased knowledge of energy consumption
Neighborhood activities	Changes in all relevant technical factors	Conservation costs reduced by cooperative efforts	Sponsored by local government	Convey information about neighborhood activities	Develop neighborhood activities	Acquire experience with conservation
Organizational actions	Changes in all relevant technical factors	Conservation costs reduced by cooperative efforts	Government cooperation with private organizations	Convey information about organization actions	Develop organization actions	Acquire experience with conservation
Community programs	Changes in all relevant technical factors	Conservation costs reduced by cooperative efforts	Government development and financing	Convey information about community programs	Develop community programs	Acquire experience with conservation
Monetary incentives	Changes in all relevant technical factors	Offer cheaper energy conserving equipment	Government provide subsidies	Convey information about available subsidies	Support by organizations and communities	Increased consumer awareness of energy costs
Price increases	Changes in all relevant technical factors	Increase energy prices or alter rate structures	Government increase taxes on energy	Convey information about energy prices	Support by organizations and communities	Increased consumer knowledge of energy prices
Energy Surtax	Changes in all relevant technical factors	Increased labor-intensive production	Government administer the tax	Convey information about the surcharge	Support by organizations and communities	Development of a conservation ethic
Energy standards	Changes in all relevant technical factors	Industry set voluntary product standards	Government impose and enforce standards	Convey information about energy standards	Support by organizations and communities	Increased awareness of energy use efficiency
Energy allocation	More energy efficient products	Creation of a "white market" for energy allocations	Government impose and enforce	Convey information about allocation schemes	Support by organizations and communities	Increased awareness of energy systems
Community design	Construction of multi-family dwellings	Cooperation of local businesses	Legal actions by local government	Convey information about community design	Support by organizations and the community	Development of a conservation ethic

and transportation networks. Such changes would be accomplished through the use of community planning, zoning and building requirements, public ordinances, and other legal actions by the community or other governmental agencies (Harwood, 1977). The goals of these efforts might include constructing more multi-family dwelling units, redevelopment of inner-city areas to attract middle-class residents, locating industries in "industrial parks" with nearby housing for their workers, developing new forms of transportation such as "moving sidewalks" or "people movers," or organizing cities into "neighborhood clusters" containing all necessary facilities and services within easy walking distance. At the present time we can only speculate about the amount of energy that might be saved in such communities, although it might well amount to one-third or even one-half of our present consumption (Harwood, 1977).

Implementation Factors

In Section II we saw that consumer energy use is shaped by a wide variety of controlling contexts, which were categorized under the headings of technical, economic, governmental, media, social, and personal. As implementation instruments are employed to create social change, several of these controlling conditions are likely to be affected. Consequently, a thoroughly planned strategy will determine in advance which of these conditions -- which we term relevant implementation factors -- can and should be changed. In other words, which features or actors in the controlling contexts are to be manipulated or engaged by the proposed implementation instruments? After these instruments and their related operational programs are actually enacted, it is then vital to determine which implementation factors are altered or engaged by them.

Each implementation instrument is likely to affect a unique set of implementation factors, although there will undoubtedly be numerous overlaps among these different sets. Figure 4 is a matrix composed of our twelve instruments and six types of factors. Within each cell of the matrix we indicate factors that might be particularly critical with each implementation instrument. The matrix can thus be viewed as a set of hypotheses concerning the most important linkages between implementation instruments and factors in the process of promoting consumer energy conservation. Each implementation instrument is linked to a number of relevant factors, and in reality these may occur as a sequential series of changes in which one factor affects another, which then affects another, and so on. Although such sequences are not depicted in the matrix, one illustration of them would be the case of providing consumers with information about techniques for conserving energy. Information programs might be developed by a number of governmental agencies and private organizations. The media would then transmit these programs to consumers in various ways. If this communication effort were successful, it would increase people's knowledge of possible conservation practices. Finally, this knowledge hopefully would be used by consumers to make energy-saving changes in their household and transportation technical equipment.

IV. OUTCOMES OF CONSUMER ENERGY CONSERVATION POLICIES

The purpose of any public policy strategy is to have some effect on individuals and society -- such as promoting greater energy conservation. A strategy may produce numerous kinds of outcomes, however. Some of these outcomes will be attitudinal changes within individuals, while others will be overt actions. Some outcomes will be obvious at the individual level, while others will be visible primarily at a collective level such as a community or society. Some outcomes will be intended, while others will be partially or wholly unintended. Finally, some outcomes will be desired, while others may not be. In this section we discuss four different sets of outcomes that might result from strategies designed to promote consumer energy conservation.

Consumer Responses

As governments propose using various strategies to enact their energy conservation policies, people will initially respond to those proposals in various verbal ways. To predict probable consumer responses to proposed energy conservation strategies, therefore, we must take into account people's views toward the instruments that will be employed to implement the conservation policy, the extent to which key factors affecting their energy consumption and other aspects of their lives will be altered by those instruments, and their feelings about the long-range goals of that policy.

Four kinds of possible consumer responses are discussed in the following paragraphs. Every individual may not evidence all four kinds of responses, but all of them should occur across populations. Because these responses are all verbal reactions to proposed policy strategies, they can be analyzed prior to the time when the strategies are actually enacted. Hence it is possible to obtain feedback from the public concerning alternative strategies, and to incorporate this feedback into the final selection process.

Policy acceptance. This type of response, which is usually the first one that people make to a proposed policy, is an overall evaluation of the policy goals and strategies. In brief, they either like or don't like the policy. This response can be specified in greater detail, however, by ascertaining at least four distinct dimensions of polic acceptance:

1. Personal attitude toward the policy strategy.
2. Perceived probable effectivness of the policy strategy.
3. Perceived desirability of the policy strategy for the society.
4. Willingness to support the policy strategy if adopted.

The major finding that has emerged from previous research on public acceptance of energy conservation policies is that rather large proportions of the population say that they would accept many fairly stringent conservation measures if they became necessary and if they were implemented fairly (Olsen and Goodnight, 1977; Zimmerman, et al, 1978). For example, a recent national survey in the U.S. reported that the following programs would be acceptable to a large majority of the American population: mandatory conservation standards for new buildings; mandatory energy efficiency standards for all appliances; taxing domestic oil to raise its price to the world level; and allocation of fuels by the government according to need (Milstein, 1977). If these data are valid, they suggest that the public may be much more ready to accept financial and regulatory conservation strategies than many political leaders believe. Respondents in these studies have insisted, however, that all such instruments employed by the government must be implemented in a fair manner, so as to neither harm nor benefit any particular groups or classes of people.

Conservation commitment. Quite conceivably, people might accept a proposed strategy and be willing to support it because they thought it would be effective and beneficial for the country, but at the same time refuse to let it affect their own attitudes or actions. Hence it is also necessary to measure the extent to which a proposed energy conservation strategy would affect people's personal commitment to conservation. Four important dimensions of personal conservation commitment are the following:

1. Interest in different forms and meanings of energy conservation.
2. Perceived importance of energy conservation for oneself or society.
3. Sense of personal responsibility for energy conservation efforts.
4. Feeling of control over one's energy consumption, and one's ability to change it as desired.

Action intentions. As people become increasingly committed to energy conservation, they will likely begin to think about specific actions they might take to save energy, and to formulate plans for those actions. These might include intentions to alter one's consumption patterns, to consider energy costs when purchasing appliances, to make conservation improvements in one's home, or to buy a smaller car. The next set of consumer responses to be considered, therefore, consists of the specific conservation actions that people would intend to take if a proposed conservation strategy were implemented. Measurement of these intentions, which might be divided into the following four categories, should include both the particular actions to be taken and the strength of these intentions to act:

1. Space conditioning, especially heating.
2. Appliance use, especially hot water heaters.
3. Personal travel, especially by auto.
4. Major lifestyle modifications.

Anticipated impacts. The actual impacts that an energy conservation policy might have on other sectors of society cannot be known with certainty prior to its being enacted. Nevertheless, when people evaluate proposed policy strategies, they often take into account the additional impacts that they believe might result from those strategies. Hence it is useful to explore these anticipated impacts before an energy conservation strategy is actually adopted. Four areas of such anticipated impacts are these:

1. Economic impacts, including employment, income levels, inflation, economic growth, and socioeconomic equity.

2. Social impacts, including community cohesion, class conflict, family stability, and population migration.

3. Political impacts, including extent of government planning, power centralization or decentralization, and political movements.

4. Personal impacts, including effects on one's economic security, lifestyles and personal relationships, and standard of living.

Conservation Actions

The actual conservation actions that consumers take to reduce their energy consumption cannot be determined until after implementation strategies have been adopted and specific conservation programs have been developed and carried out by governments. When that does occur, however, the analysis of policy outcomes can go beyond verbal consumer responses to measure overt conservation actions taken by individuals and households.

Thus far -- as we saw in Section I -- most consumer actions have been limited to steps that require minimal effort and expense, but do not significantly reduce energy consumption. Typical examples are turning off unnecessary lights, turning the furnace thermostat down a few degrees (1-2° C or 2-4° F), and closing off unused rooms (Olsen and Goodnight, 1977; Cunningham and Lopreato, 1977; Olsen and Cluett, 1979). There is some indication, however, that in the past year or two more people have begun to take some serious conservation actions. For instance, recent polls in the U.S. have reported that over half of the respondents say they have added more insulation to their homes or have put caulking and weather-stripping around doors and windows (Gallup, 1978). Nevertheless, it is crucial to note that none of the existing data on conservation actions have been specifically related to any of the implementation instruments or factors discussed in Section II. When it becomes possible to study the conservation actions produced by various policy strategies, it will be necessary to identify (1) the intended conservation goals being sought, (2) the instruments that are adopted to attain those goals, (3) the programs that are developed to carry out those instruments, and (4) the factors that are changed by those instruments and programs. With that information, it will be possible to measure the influence of each strategy in promoting consumer conservation actions.

Energy Savings

The ultimate goal of any energy conservation policy is to reduce the total consumption of energy from nonrenewable sources. Hopefully, therefore, the various actions that consumers take as a result of any strategy employed by government to promote energy conservation will result in considerable energy savings. This may not necessarily happen, however, under either of two conditions: (1) The conservation actions taken by consumers are basically symbolic in nature, giving people a feeling that they are contributing to the conservation effort, but not producing significant energy savings. (2) The "Boomerang Law of Energy Conservation" (Hayes, 1976:63) occurs among these consumers. This law states that "(1) whenever we save energy we save money; and (2) whatever we spend that money on will require energy." For instance, if a family sells its automobile to save energy, but then takes a vacation trip by airplane, it may end up consuming more energy than it would have with a car. Unless consumers are fully aware of the energy they are consuming in all their activities and purchases, a conservation policy that does not attempt to alter basic consumption styles may prove to be totally ineffective in the long run.

A thorough evaluation of any energy conservation policy must therefore attempt to measure the actual energy savings achieved by consumers in electricity, heating fuels, and gasoline. This task entails two demanding methodological problems, however: (1) Data must be obtained on people's energy consumption levels prior to taking any conservation actions, which can become quite complicated with energy consumption that is not metered (such as oil, coal, and gasoline), or when utilities refuse to grant access to their billing records. (2) To measure energy savings, the analysis must compare consumers' energy consumption after they took conservation actions with what those consumption levels would have been without the actions, always taking into account current weather conditions. This comparison can be made in either of two ways, both of which have serious disadvantages for the researcher: (a) A control group can be selected that is identical to the experimental group of consumers on all variables affecting energy consumption, and then be restrained from taking any conservation actions during the course of the study. Both of these requirements are extremely difficult to achieve in any social research, however. (b) On the basis of a consumer's past record of energy consumption prior to taking any conservation actions, a regression equation can be constructed to predict the amount of energy that consumer would have used without any conservation actions. Although this procedure is more empirically rigorous than the alternative procedure of matching control and experimental groups, it is immensely demanding in any large-scale study , since a separate regression equation must be constructed for each respondent. Moreover, it assumes that a sufficient number of measurements of past energy consumption can be obtained for each consumer, which is often impossible. There is no easy solution to this dilemma, so that a researcher will simply have to use whichever procedure is most feasible in a particular study.

Social Impacts

The intended outcome of conservation actions taken by consumers is to reduce their consumption of nonrenewable energy. At the same time, however, these actions -- or a resulting lowered demand for energy -- may have other consequences for the society. If these social impacts are considered desirable, they are a side benefit of the energy conservation policy.

If the impacts are considered undesirable for society or individuals, however, they must be viewed as additional costs of the conservation policy. They should then be taken into accoutn in evaluating the success of the policy and deciding whether to discard, continue, or expand it.

Very little attention has been given thus far to the problem of how to assess the social impacts of broad public policies. Hence we cannot specify a precise procedure for examining this final aspect of the process of promoting consumer conservation. Four observations about such impact assessment can be made, nevertheless: (1) The concept of "social impacts" should be taken in its broadest meaning, to include effects on the economy, the political system, communication processes, organizational activities of all kinds, personal living conditions and lifestyles, and the overall quality of life in a society. (2) If done properly, this analysis will be quite demanding in both breadth and depth, and hence must not be approached as merely "something to be done as quickly as possible to satisfy a federal requirement." (3) The assessment will inevitably involve making numerous value decisions about what is and is not significant impact, and what constitutes a desirable or undesirable impact. (4) This analytical process can be conducted in a systematic manner only if it employs a rigorous methodology -- such as measuring all impacts with standardized social indicators (Olsen, et.al., 1978) -- rather than merely relying on the subjective judgements of researchers, as has frequently been done in past social impact assessments.

The social impacts of energy conservation will undoubtedly be considered desirable by some parts of society and undesirable by others. Some of these impacts will benefit some people, some impacts will benefit others, some impacts will hurt some people, and other impacts will hurt still others. These conditions will very likely generate considerable social conflict and political debate. The outcomes of these controversies will depend largely on the strategies and impacts of consumer energy conservation policies and the techniques that are employed to manage their social impacts. Social science research can contribute significantly to our understanding of both the strategies and impacts of consumer energy conservation. Moreover, such research might demonstrate that the conservation of energy need not entail an unpleasant sacrifice of current comforts, but rather could lead to numerous improvements in the quality of human life (Olsen, 1979).

Footnotes

1. United States = 34%; Great Bitain = 38%; France = 37%; West Germany = 46%; Sweden = 29%, (Newman and Day, 1975: 8; Darmstadter, et.al., 1977:29).

2. We will not deal with the indirect consumption of energy that occurs whenever a person buys an energy-intensive product (such as steel, aluminum, paper, cement, and plastics), since reducing the amount of energy required to produce these goods is largely a technical problem that is commonly placed within the industrial sector. And even if consumers do wish to avoid purchasing energy-intensive goods, this can be very difficult because (1) they have no way of knowing how much energy is embedded in each product, and (2) adequate non-energy-intensive goods are often not available.

3. Little research has been conducted on the institutional and personal dimensions of new energy conserving fuels and technologies. A few relevant works are Campbell, et al., 1977; Council on Environmental Qualitz, 1978; Klein, 1979; and Krusche, 1979).

4. This topic of energy rates has been extensively studied by economists. See Doctor, et al., 1972; Düwall, 1976; G. Hannon, 1974; Lebanon, 1977; Luhmann, 1978; Luther, 1978).

5. These different types of social change instruments are discussed more fully in Olsen and Goodnight, 1977. See R. Warren, 1978, for a more theoretical analysis of ways of intentionally creating social change.

6. For a review of all these studies, see Ellis and Gaskell, 1978.

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Attachment 8-B

EVALUATION OF THE SEATTLE CITY LIGHT NEIGHBORHOOD ENERGY CONSERVATION PROGRAM

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Battelle Human Affairs Research Centers

Executive Summary

During 1978, Seattle City Light conducted a trial Neighborhood Energy Conservation Program based on the principle of implementing conservation through neighborhood activities and personal contacts. The effectiveness of the program was evaluated by the Battelle Human Affairs Research Centers.

The three neighborhoods selected for the program each received different activities: Green Lake received a neighborhood information campaign in which City Light worked with the local community council and other organizations to promote conservation awareness and distribute conservation literature throughout the neighborhood. Haller Lake received a series of block conservation workshops conducted by City Light personnel in the homes of local residents, to which all the people living on that block were invited, the purpose of which was to demonstrate household energy conservation techniques. Mt. Baker received both a neighborhood information campaign and block-level workshop. In all three neighborhoods, residents were strongly encouraged to request free home energy checks by City Light conservation specialists, who examine the structure of a home and it's energy use, and then suggest various actions that could be taken to reduce energy consumption.

These three neighborhoods were chosen for the study primarily because they contained households of widely varying socioeconomic status and a high proportion of homeowners (the study was limited to homeowners). Approximately ten blocks within each neighborhood were randomly selected for this study.

Residents of the three neighborhoods were exposed to several different combinations of program activities. Some people received conservation information through a neighborhood comapign, a block workshop, and a home energy check. Other people were exposed to various combinations of two of these activities, and still others experienced just one City Light activity. In addition, a number of people in each neighborhood did not expose themselves to any of the available activities, but did report talking with their neighbors about energy conservation. Finally, those residents who did not take part in any program activities and did not discuss conservation with neighbors constituted the "control population" for this study.

The effects of the City Light program were evaluated in six ways: (1) At the beginning of the study, all residents of the selected blocks within the three neighborhoods were sent an initial mailed questionnaire containing questions about their energy conservation attitudes, knowledge, and previous actions, plus relevant sociodemographic data. Completed questionnaires were received from 484 homeowners. (2) Everyone who attended a block workshop filled out a written evaluation form on the workshop. (3) At the end of the study, all participants who had completed the initial questionnaire and had not changed residences during the intervening months were telephoned and asked a series of questions about the conservation actions they had taken both prior to and during the study, as well as the extent of their exposure to the City Light program. A total of 36? of these post-interviews were completed. (4) All respondents to the telephone interview were then mailed a written post-questionnaire that asked about their energy conservation attitudes and knowledge at that time, plus several questions about their willingness to invest money in home conservation actions such as adding insulation to their house. (5) In July, 1979, the 157 households remaining in the study were again interviewed by telephone to determine what energy conservation actions they had taken since the post-interview in November, 1978. (5) To measure energy savings achieved through the City Light program, actual consumption records for electricity, natural gas, and heating oil usage by these households were analyzed. This was done in two phases: Phase I covered just the months of May through November, 1978, and was limited to a subsample of 30 all-electric homes. Phase II examined the entire period of the study from May, 1978, to July, 1979, and included homes heated with natural gas or oil as well as those with electric heating. Electricity consumption records for all the households in the study were provided by City Light, consumption records for the natural gas customers were made available by Washington Natural Gas Company, and consumption records for the oil customers were obtained from all of the 30 private oil dealers who serviced those households. The analysis in both phases used regression equations constructed for each household (with separate equations for electricity and gas or oil use) that held constant the effects of weather conditions on energy consumption. Each equation was based on a baseline period prior to the start of the City Light program, and was then used to predict that household's expected level of energy consumption after May, 1978, provided it took no conservation actions. If its actual consumption levels were significantly lower than the predicted levels, this indicated that the household had saved energy--presumably as a result of exposure to the City Light program.

The results of the initial questionnaire revealed that most of the respondents held relatively positive attitudes toward energy conservation. For example, 91% either strongly or mildly agreed with the statement that "Greater energy conservation must be a vital goal for American society for the rest of this century." Their knowledge about specific conservation actions was somewhat lower, however. Only two-thirds of the respondents knew that the hot water heater is the most energy-consuming home appliance, and only one-fifth of them knew that caulking and weatherstripping will pay for itself in less than one year. In terms of conservation actions, two-thirds to three-fourths of the respondents said that they "almost always" did such things as turning off unused lights and keeping the thermostat at 65°, while half of them said they had taken such steps as adding more insulation to their home or turning down the temperature on the hot water heater. These figures are almost certainly exaggerated, however, since much lower rates for these same actions were obtained in the post-interviews when respondents were asked to list (without any suggestions from the interviewer) all the conservation actions they had taken.

Evaluations of the block workshops by those who attended them were uniformly positive. Almost all the participants thought that the workshops were quite useful, and most people said that they learned a great deal about both the nature of the energy problem in Seattle and specific techniques for saving energy in the home.

The City Light program did not apparently affect people's general attitudes toward energy conservation. Among respondents who completed both the initial and post-questionnaires (which contained identical sets of attitude questions), there was no increase in favorable attitudes toward the importance of conservation, regardless of the extent of their exposure to the City Light program. This finding is not surprising, considering the high level of pro-conservation attitudes that existed at the beginning of the program and the emphasis of the program on conservation techniques rather than attitude.

To measure information acquired about specific energy conservation practices, eight factual questions from the initial questionnaire were repeated in the post-questionnaire. In general, persons who were exposed to the City Light program improved their knowledge scores somewhat more than did those with no exposure and those who only talked with friends about conservation. Increased knowledge about conservation was especially evident among people who both attended a block workshop and had a home energy check. On the whole, however, the amount of information gained by program participants was not very substantial on the items measured.

To determine whether exposure to the City Light program led people to take home energy conservation actions, three weighted action indexes were constructed: one measured all actions taken prior to the program, the second measured all actions taken between May and November, 1978, and the third measured all actions taken between approximately July, 1978, and July, 1979. An initial analysis performed with the first two indexes revealed that households exposed to the City Light program scored considerably higher on the second index than did those with no exposure or only discussion with friends. This difference remained after scores on the first index of pre-program actions were held constant, and was particularly evident among households that had not previously taken any conservation actions. The highest scores on the second index occurred among persons who were exposed to all three aspects of the City Light program: neighborhood information campaign, block workshop, and home energy check.

A subsequent analysis used the first and third indexes to determine if having a home energy check led people to continue taking conservation actions throughout the following year. The results showed that households with a check scored twice as high on the third index as did those without a check, regardless of type of heating. When pre-program index scores were taken into account, energy check households had conservation action scores that were three times as high as other households.

The two factors mentioned most frequently as reasons for taking energy conservation actions were a desire to contribute to solving the energy problem and a concern to reduce household energy expenses. Neither of these factors were strongly related to the number of conservation actions taken during the course of the study, however. In contrast, people who said that they were strongly influenced by a home energy check, attending a block workshop, or participating in this study had relatively high scores on the post-program action index.

The initial analysis of consumption data for 30 all-electric homes between May and November, 1978, demonstrated that exposure to the City Light program did save electricity. Those households reduced their electricity consumption an average of 3.2 kilowatt hours per day during the summer, when electricity use for heating was minimal.

The subsequent analysis of consumption records between May, 1978, and July, 1979, demonstrated that all-electric homes with a home energy check lowered their electricity consumption an average of 5.6 kilowatt hours, for an energy savings of 8.6 percent, whereas all-electric homes without a check continued to use approximately as much electricity as expected. Home energy checks also appear to reduce electricity consumption in homes heated with natural gas or oil, although these savings are not as great. In addition, both natural gas and oil consumption decline following a home energy check. The apparent reductions in oil usage are much larger than for natural gas, but this difference is likely due to the imprecise nature of the data on oil consumption. Finally, this analysis indicated that conservation action scores are not related to actual consumption savings. Households that have a home energy check consistently save more energy than do those without a check, regardless of what actions they say they have or have not taken to conserve energy.

Respondents in this study were relatively aware of the importance of adequate home insulation as a means of reducing household energy consumption, but were concerned to hold down the cost of such conservation investments as much as possible. Consequently, many people would like to do part or all of the work themselves. Respondents were also concerned about the expected payback period of any investment they made, although they were willing to accept moderately long payback periods—such as an average of 4.5 years on a $600 investment. The availability of loans for financing such household conservation investments was not important to most of these respondents, however. Among eight different factors that might influence one's decision to invest in conservation, this consideration ranked last among all segments of the sample. One-third of the respondents said they would never consider taking out a conservation loan, and the rest of them said that, on the average, they would prefer to pay close to $600 in cash for such home improvements before obtaining a loan. If they must take out a conservation loan, they

prefer a low-interest or no-interest plan of the type presently being offered by two utilities in the Seattle area.

On the basis of these findings, several recommendations are offered: (1) The home energy checks be continued by City Light and extended as widely as possible. (2) The block workshops be viewed primarily as a means of promoting home energy checks, rather than as a procedure for directly stimulating people to take household conservation actions. (3) Since attempting to hold a workshop on every block in the city would be prohibitively expensive, City Light employ several other means of promoting home energy checks, including (a) holding block workshops on selected blocks where a concentrated City Light conservation effort would be highly visible; (b) conducting a series of neighborhood-level workshops in neighborhood centers; and (c) working with existing neighborhood and community organizations to help them promote energy conservation awareness and home energy checks. (4) Emphasis be placed on household energy conservation actions that are relatively inexpensive that can be carried out by residents themselves, with a maximum cost of $500-$600 and a payback period of no more than five years.

We conclude that the Seattle City Light Neighborhood Energy Conservation program has demonstrated that a voluntary approach to promoting conservation will work if it goes beyond mere exhortation by providing consumers with suggestions for specific and inexpensive actions they can take to reduce their energy consumption, and if it reaches consumers through personal contacts such as home energy checks and neighborhood conservation workshops.

Attachment 8-C

Washington Energy Extension Service

December-January Free Programs

Steve Denner, Energy Extension Agent
312 Smith Tower • Seattle, WA 98104
344-3440

solar energy

HERE COMES THE SUN
Solar energy for the Pacific Northwest
Wednesday, December 26 12:30 pm-1:30 pm
Federal Building 2nd floor Cafeteria, 2nd & Marion

SOLAR STORAGE IN ROCK
Engineer Ed Shope discusses rock bin design
Wednesday, January 9 7:00 pm-8:30 pm
Seattle Central Community College Rm BE 4179

ENERGY SAVING PASSIVE SOLAR HOME DESIGN
Tom Lenchek, architect, shows how to use the sun
Thursday, January 17 7:00 pm-8:30 pm
Green Lake Public Library, 7364 E Green Lake Dr. N.

INTRODUCTION TO SOLAR WATER HEATING
Commercial & do-it-yourself systems
Thursday, January 24 12 noon-1:00 pm
Smith Tower Room 620, 2nd and Yesler

BUILD YOUR OWN SOLAR GREENHOUSE
For heat and food production
Thursday, January 24 7:00 pm-8:30 pm
Puget Power Auditorium, 10608 N.E. 4th, Bellevue

MONITORING SOLAR HEATING INSTALLATIONS
Terry Bratvold, WNG, discusses methods & equipment
Wednesday, January 30 7:00 pm-8:30 pm
Washington Natural Gas, 815 Mercer St.

HERE COMES THE SUN
Solar energy for the Pacific Northwest
Thursday, January 31 7:00 pm-8:30 pm
Seattle Central Community College, Rm 1110

home energy conservation

HEAT PUMP CLASS
How they work, how much energy they use
Thursday, January 3 12 noon-1:00 pm
Smith Tower Room 620, 2nd and Yesler

MAINTAIN YOUR FURNACE: GAS OR OIL
Reduce fuel bills with proper furnace care
Thursday, January 3 7:00 pm-8:30 pm
Smith Tower Room 620, 2nd and Yesler

SEATTLE/KING COUNTY ENERGY MGMT. PLANS
Overview of current & future policy & regulations
Thursday, January 10 12 noon-1:00 pm
Smith Tower Room 620 2nd and Yesler

EARTH-SHELTERED HOUSING
Dennis Scase on underground domes
Thursday, January 10 7:00 p.m.-8:30 pm
Green Lake Public Library, 7364 E. Green Lake Dr N.

A WORKSHOP: STORM WINDOWS
Learn about storm windows by building them yourself
Saturday, January 12 12 noon-4:00 pm
Call 344-3440 and ask for application HC-22

INSULATE YOUR HOME
Learn about insulating floors, ceilings walls
Wednesday, January 16 7:00 pm-8.30 pm
Queen Anne Public Library 400 W Garfield

PUGET POWER'S FREE HOME ENERGY SURVEY
Hunt Branham of Puget Power
Thursday, January 17 12 noon-1:00 pm
Smith Tower Room 620, 2nd and Yesler

INSULATED WINDOW COVERINGS CLASS
Information on curtains, shades, shutters
Thursday, January 17 7:00 pm-8:30 pm
Shoreline Public Library, 345 N.E. 175th

CAULKING AND WEATHERSTRIPPING DEMO
Learn how to plug those expensive leaks
Wednesday, January 23 7:00 pm-8:30 pm
Kirkland Library, 406 Kirkland Ave.

THE ENERGY EFFICIENT HOME
Learn how your home is wasting energy, costing money
Thursday, January 24 7:00 pm-8:30 pm
Seattle Central Community College, Rm 1110

A WORKSHOP: INSULATION
Hands-on training in insulation techniques
Saturday, January 26 12 noon-4:00 pm
Call 344-3440 and ask for application HC-23

STORM WINDOW CLASS
Introduction to storm windows for your home
Wednesday, January 30 7:00 pm-8:30 pm
Federal Way Public Library, 848 S. 320th

ENERGY CONSERVATION FOR RENTERS
Low-cost energy saving investments
Thursday, January 31 12 noon-1:00 pm
Smith Tower Room 620, 2nd and Yesler

wood heat

WOOD STOVES: INSTALLATION AND OPERATION
Safety and clearances
Wednesday, December 19 7:00 pm-8:30 pm
Kingsgate Library, 12315 N.E. 143rd, Kirkland

A FORESTER LOOKS AT WOOD AS FUEL
Arno Bergstrom discusses types of wood
Thursday, December 20 7:00 pm-8:30 pm
Kent Library, 232 S. 4th

FIREPLACE COVER CLASS
How to build this energy saver yourself
Thursday, December 27 12 noon-1:00 pm
Smith Tower Room 620, 2nd and Yesler

AN INTRODUCTION TO WOOD HEAT
Fireplace modifications & choices of wood
Thursday, January 10 7:00 pm-8:30 pm
Seattle Central Community College, Rm 1110

FIREPLACE COVER CLASS
How to build this energy saver yourself
Wednesday, January 16 7:00 pm-8:30 pm
Puget Consumers Coop, 10718 N E 68th, Kirkland

AN INTRODUCTION TO WOOD HEAT
Fireplace modifications & choices of wood
Wednesday, January 23 12 noon-1:00 pm
Bell Plaza Auditorium, 1600 7th Ave.

HARVESTING YOUR OWN FUELWOOD
Where and how to cut wood
Wednesday, January 23 7:00 pm-8:30 pm
Queen Anne Public Library 400 W Garfield

Washington State University in cooperation with the U.S. Department of Energy and the Washington State Energy Office

SESSION 9. STRATEGIES FOR FINANCIAL ENERGY MANAGEMENT

Student Outline

A. Principles of the financial approach

1. Purpose
2. Two forms
3. Desirable features
4. Undesirable features

B. Pricing techniques

1. Main characteristics
    a. Intention
    b. Theory
    c. Instruments
    d. Techniques
2. Price deregulation
    a. Characteristics
    b. Effectiveness
3. Energy surtax
    a. Characteristics
    b. Effectiveness
4. Evaluation of pricing techniques

C. Incentive techniques

1. Main characteristics
    a. Intention
    b. Theory
    c. Instruments
    d. Techniques

2. Inducements

   a. Characteristics

   b. Effectiveness

3. Deprivations

   a. Characteristics

   b. Effectiveness

4. Evaluation of incentive techniques

D. Class discussion

Reading Assignment

Seymour Warkov, Energy Policy in the United States, Chaps. 6, 10

Suggested Reading:

Cunningham, William H. and Lapreato, Sally Cook. 1977. Energy Use and Conservation Incentives, New York: Praeger Pub., pp. 76-92

Willenborg, John F. and Pitts, Robert E., "Gasoline Prices: Their Effect on Consumer Behavior and Attitudes," Journal of Marketing, Vol.41, 1977, pp. 24-31.

PROBLEMS WITH PRICING TECHNIQUES

1. The short-term elasticity of energy consumption is very low, because much energy consuming equipment cannot be altered, and is too expensive to replace until it is worn out, which may take several years.

2. Many of the benefits of energy consumption, such as a warm house or an automobile, are functionally indispensible and highly desirable to most people, so that they will pay whatever is necessary to purchase energy.

3. There is a "response threshhold" below which price increases will not significantly affect consumption (estimated to be between 40% and 75%), which is particularly significant during periods of rapid inflation.

4. Energy price increases affect the cost of many goods and services, which increases the rate of inflation and triggers higher wage demands and levels in a continual spiral.

5. Price elasticities apply only to direct consumption of energy; and the 45% of all energy that is consumed indirectly by being imbedded in the production of goods is impervious to price increases because it is hidden from consumers.

6. With nonrenewable energy sources, price increases do not usually significantly reduce consumption until the available supplies are already quite low or exhausted.

7. The "Boomerang Law of Energy Conservation" may operate, in which money saved through one form of conservation may in turn be spent on other activities that are even more energy intensive, such as taking a trip by plane rather than by auto.

8. Price increases are economically inequitable, imposing severe financial hardships on low-income people who have little or no margin for reduced consumption, while having little effect on high-income people who are large energy consumers because they can continue to afford high energy prices.

9. Price deregulation gives energy producers hugh "windfall" profits that may not be reinvested in new energy development, while energy taxes give governments large amounts of revenue that may not necessarily be used to solve the energy problem.

10. Many pricing strategies are intensely disliked by the public and may be strongly resisted through boycotts, political actions, or mass protest.

SESSION 10. STRATEGIES FOR MANDATORY ENERGY MANAGEMENT

Student Outline

A. Principles of the mandatory approach

1. Purpose
2. Two forms
3. Desirable features
4. Undesirable features

B. Regulatory techniques

1. Main characteristics
   a. Intention
   b. Theory
   c. Instruments
   d. Techniques
2. Energy standards
   a. Characteristics
   b. Effectiveness
3. Energy allocation
   a. Characteristics
   b. Effectiveness
4. Evaluation of regulatory techniques

C. Design techniques

1. Main characteristics
   a. Intention
   b. Theory
   c. Instruments
   d. Techniques

2. Community development

    a. Characteristics

    b. Effectiveness

3. Community planning

    a. Characteristics

    b. Effectiveness

4. Evaluation of design techniques

D. Local government energy management programs

1. Organization

2. Programs

Reading Assignment

Seymour Warkov, Energy Policy in the United States, Chap. 7.

Suggested Reading:

McGregor, Gloria Shepard, "Davis, California: A Pace-Setting Energy Conservation City," Environmental Comment, Urban Land Institute, July, 1977.

Lans, Ken, "Seattle Proposes Mandatory Conservation," Solar Washington, Vol.1, Jan./Feb. 1980

Harwood, C.C. 1977. Using Land to Save Energy. Cambridge: Ballinger Pub.Co., pp. 11-35.

ADDITIONAL INFORMATION

Public Technology, Inc. has available a series of Energy Dispatches, Information Bulletins, Management Reports and Technical Guides relating to many aspects of Local Government Energy Management. A listing of available publications can be requested from:

Publications and Distribution
Public Technology, Inc.
1301 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

For further information, contact the Energy Program, PTI, at (202) 626-2400.

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