U.S. ENERGY CONSERVATION PROGRAM: ORGANIZATION AND MANAGEMENT

Dmitri V. Kuzin
Graduate Student Summer Program

September 1978 WP-78-44

2361
Laxenburg
Austria

International Institute for Applied Systems Analysis

CONTENTS

INTRODUCTION

Program management has become an important issue today. The governments in many countries and on different levels use different programs whose essence sometimes is very different, too. The current stage of modern development includes a scientific-technological revolution (STR) in which large-scale complex problems have emerged which cannot be solved by ordinary separate government actions. These require new organizational mechanisms. Various programs in different countries vary in specific features of program management according to the character of the program, the economic potential of the country, its social system, and many other factcrs. In their implementation, however, they can have much in common.

One of the main consequences of the STR has been structural changes in the economy. The changes are the following:

- resource changes (material, human, information),
- sector changes,
- technological changes, and
- regional changes.

For each of these areas has emerged a set of programs. There are several reasons for taking the energy conservation program of the USA as an object of the present study. The aspects listed above are all revealed in this program; this program is deeply connected with the economy and all key industries, it is a large-scale non-conventional program with an element of crisis in it, it has top-level government priority, and represents an example for studying the American economy.

In this article the attempt is made to understand the program using the systems approach. The author does not aim to describe all governmental actions in detail or the technical questions connected with the problem of energy conservation. There is also no program evaluation here, although it is one of the most important components of program management. The accent is rather on the decomposition of the system into related subsystems, definition of the actors involved, and interactions between them.

The author wishes to express his gratitude to Dr. A. Straszak and Professor G. Dobrov for their useful recommendations and support.

1. THE ESSENCE OF THE ENERGY CONSERVATION PROGRAM

Under the conditions of a deteriorating world energy situation, brought about as the result of constantly increasing energy demand on the one hand, and decreasing fossil energy resources on the other hand, the intensive* factors of energy use became more and more important for all countries.

We can handle the energy conservation program from several points of view:

- technological,
- economic,
- social,
- environmental,
- managerial.

The last is the more important in this study. The management mechanism for large-scale programs includes three parts:

(1) design of measures (for energy conservation, in our case);

(2) implementation of these measures; this includes the design of organizational mechanisms for all levels of administration, financial, resource and information support, as well as the plan for implementation;

(3) evaluation of the results.

The energy conservation program is a large-scale program of a specific kind and it differs from those studied in IIASA previously [1;2;3;15]. Nevertheless, it has much in common with these programs. The energy conservation program is also a complex one, intersectoral, multi-institutional and non-conventional,

*The word "intensive" characterizes the factors which improve effectiveness.

because it is directly connected with the energy crisis.

In the analysis of any large-scale program a crucial point is the question of how to distinguish the program from the given economic system. In other words, we must answer the questions as to when, where and how the program manifests itself within the economy. If the present institutional mechanism were able to solve the problems by a set of nonconnected measures of state regulation, we should not have this program. Hence, for such a program to be set up we have at least two vital conditions:

(1) the problem we are going to solve must be non-conventional and complex,

(2) the given organizational mechanism must be inadequate to handle the problem.

The resultant from the first will be the set of goals, the second will point to the necessity of connecting all the measures in order to reach these goals.

Goal-setting and goal analysis are the first steps in the program implementation [15,7]. The goals of the energy conservation program derive directly from the goals of the previously defined but still not implemented "project independence". The changes in the world energy situation since 1973 gave rise to a new set of objectives for the USA, the achievement of which required not only the new policy, but also the appropriate institutional mechanism.

Before 1973 the federal energy policy was the responsibility of a relatively small, specialized group within the administration and it had an inconsistent and fragmentary character [16,282]. The distinct interests of different groups within the nation and

the difficulty of the organizational mechanism of management after 1973 (see Appendix) required the organizational changes which took place in the form of a series of actions creating, at first, the Federal Energy Administration, ERDA, the Nuclear Regulatory Commission, and then the Department of Energy, which became the variant of the program management body.

The new national energy objective of reaching energy self-sufficiency created a sub-objective of more effective use of resources and their conservation. To achieve this objective for the entire country it was necessary to have a program which would not only unite all measures, but would also include interrelations between different sectors and groups involved in energy production and consumption.

1.1

The energy conservation program has specific features. First, its scale is much greater than those discussed earlier. It is a really national program, hence it has a more complicated structure, more actors involved, more relations, and a broader influence on the economy.

1.2

Secondly, it is interesting to compare the relationships of this program to national objectives, with the relationship in regional development programs, to the national objectives. Despite the strategic character of TVA, BITPC, BAM or North Sea Oil programs, they have no direct national objectives. The effect of these national measures is via the achievement of regional objectives, though the degree of influence of a given region on the economy as a whole differs from country to country and depends

upon many factors: global objectives of the country, the size of the country and its economic potential, the place and the role of a given region in the economy, the character of measures inside the region, etc.

However, the objectives of the energy conservation program have a national character and they are the object of serious Federal Government concern.

1.3

One of the important elements in program management is the identification of the program boundaries. The program boundary can be defined as a place in the socio-economic system where the impact of a given program ends. If these boundaries are not carefully defined, then this leads to misunderstanding of the program purpose and as a result to ineffective management. For regional development programs the boundaries can be defined easily due to their connection with a certain territory. For the energy conservation program this analysis is more difficult, both in a physical and an analytical sense because of its influence on all energy-consuming sectors of the society. That is why a careful analysis of the sectors and actors involved is needed and why the various goals of the participants should be specified.

1.4

The specific characteristic of this program is the considerable accent on R & D measures. Technologies are distinguished as a main means for problem-solving in the field of energy conservation.

1.5

One of the most important features of this program is that at the basis of its realization* lies a certain concept of conservation which determines both the character of measures developed and the character of their implementation and evaluation. The concept itself expresses a different economic understanding of this process. In the American scientific literature one can find a number of different definitions of energh conservation but in general we can divide them into two types. The first approach reflects the quantitative change in the energy use and energy demand in all sectors and as a result of it the changes in the quality of life. This approach will have a certain system of government measures to implement it (of a voluntary or legislative character). The second approach reflects the structural solution of the problem of energy conservation. It can be achieved through increasing the effectiveness of energy used by the implementation of new technologies and substitution for the present sources of energy of alternative sources. For this approach we have a different mode of realization.

1.6

The relationship between the energy conservation program and the social environment is also different from that of the previous programs. This relationship is not the same for different subprograms. Energy conservation in the public sector has a direct impact on living standards, while in industry this

*Program realization is the overall process of program design, implementation, and evaluation.

impact is of an indirect character. But research in this field is needed for two reasons: (1) to gain a better understanding of the relationships between energy and the quality of life, and (2) to identify nontechnological constraints on the implementation of measures. Besides that, energy conservation can produce a certain indirect influence on employment which is the result of the structural changes in the economy.

1.7

The intersectoral character of the energy conservation program is also different. In the regional development programs, various branches of the economy interact in order to solve one (or a set of connected) problems. Here we have a different situation, the object of influence being multisectoral. It is not the interaction of branches that achieves conservation of energy in this case, but the conservation is spread over all branches and sectors. Since the problem is complex, it requires a unique approach to each sector and to constructive interaction.

2. THE POSITION OF THE ENERGY CONSERVATION PROGRAM IN THE ECONOMIC SYSTEM AND ITS STRUCTURE

In recent years energy conservation has received primary priority among all energy programs in the USA. However, its role and place have changed during the years since 1973. As the whole program is built on the interactions of the actors, the changes in their objectives or priorities immediately influence the program. First, the main changes occur in the program environment. It is expressed in the changes in the correlation between different interest groups and also in the changes in the

in the physical environment. Secondly, the objectives of the whole program can change and will influence organization and management.

The objectives can change in two directions: either new objectives will appear (in place of the previous ones), or priorities will change. The second case is illustrated by energy conservation in the whole energy program. The conflicts between the objectives are, on the one hand, the promotion of the program (meaning the permanent changes in the organizational mechanism in order to overcome these conflicts or to minimize them) and, on the other hand, the particular constraints on program realization. This effect is seen in the U.S. energy program.

Energy conservation is a highly prominent topic today. It has certain features which complicate the organization of discussion, problem formulation, analysis, and decision-making. These features include:

- direct impact on all the sectors of the economy,
- impact on life style, income, security, aspirations,
- connections with big government, big business, big politics,
- involvement of known and speculative science and technology,
- large-scale involvement of environmental, safety and health issues,
- elements of the infinite: whole nation, whole world, all time,
- appeal to moral and ethical standards,
- an element of crisis,

- the transient nature of opportunities to correct the system [4,85-86].

All measures in energy conservation can be divided to some extent into three groups:

- technological measures and subprograms in energy conservation R & D,
- social-economic measures and economic mechanisms of program realization,
- organizational measures to improve the management structure.

We will study these aspects of the program, but first it is necessary to state the place of this program in the economic system. It can be represented with a high degree of abstraction by Figure 1. The energy conservation program is divided into six subprograms [5]. The relationship of the program and different sybsystems is the object of managerial influence. The whole management structure has three levels:

- the management of a whole program as a system,
- the management of interactions between subsystems of the program (technological, economic, social, and ecological),
- the management inside each subsystem.

From the point of view of governmental management systems this system has also three levels and each level has its own environment with which it interacts. This environment includes the business and public sectors (Figure 2).

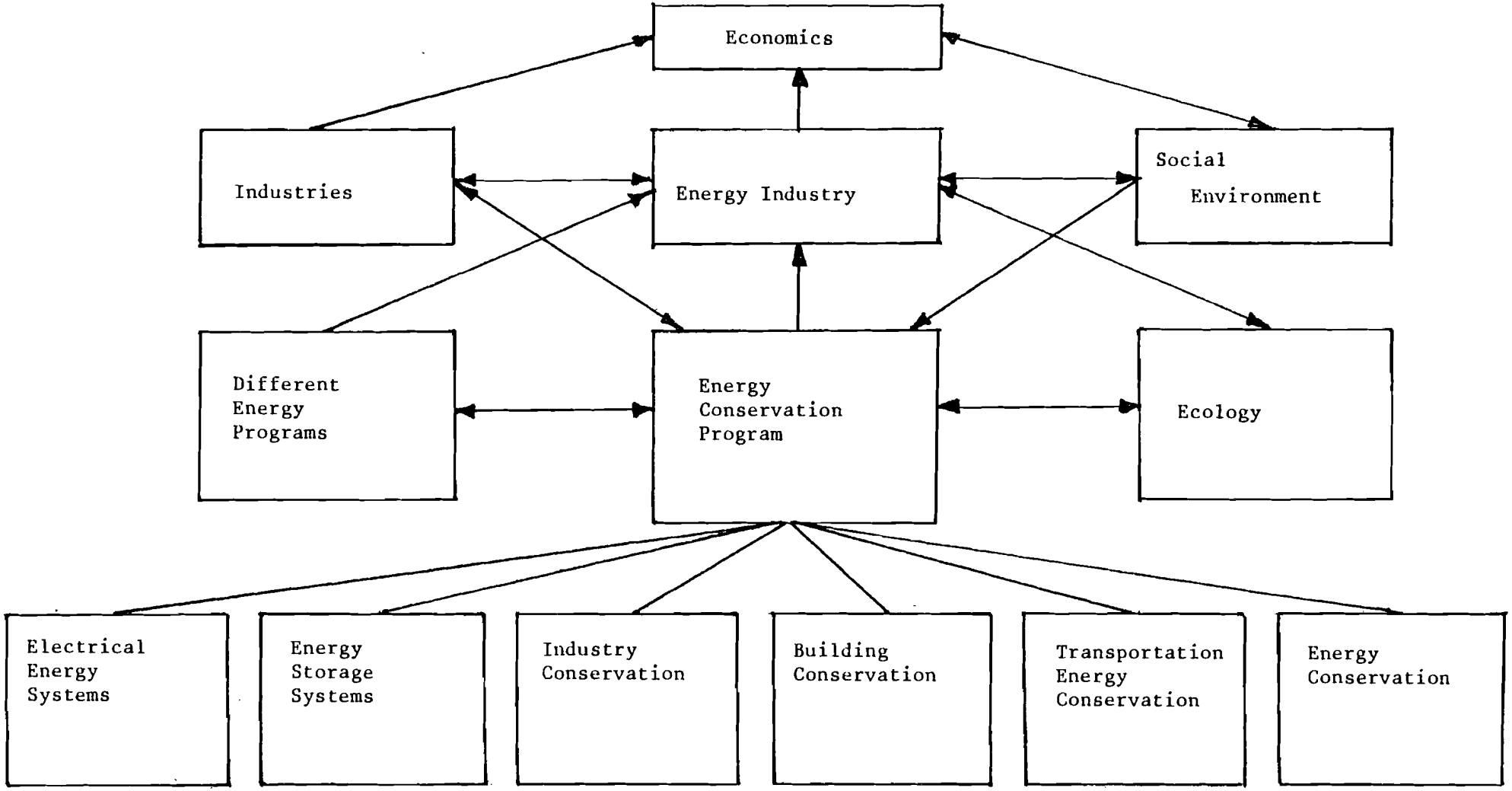

Figure 1. Energy Conservation Program Interactions

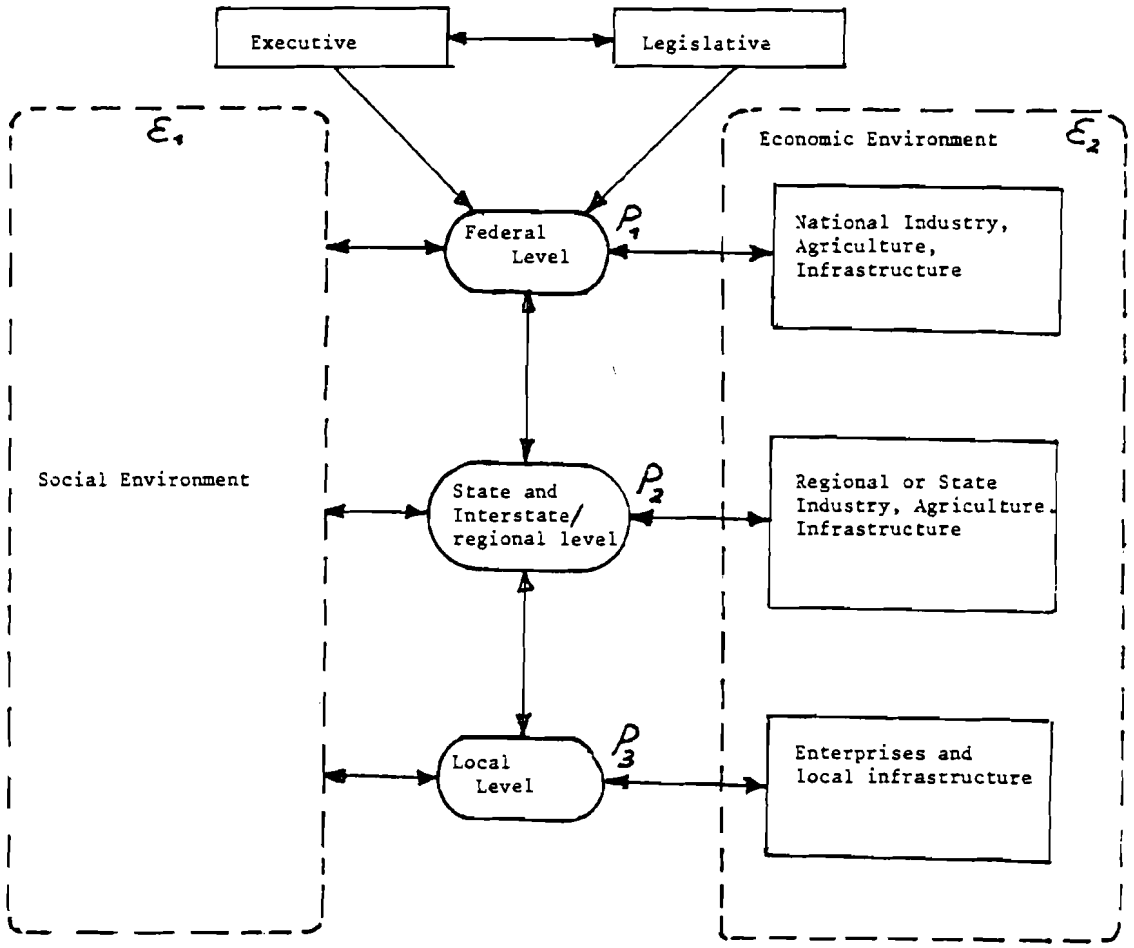

Figure 2. Program Management Structure

In Figure 2 the program environment is divided into two parts: one for the social environment, which reacts to program measures in a certain way on each level; the second for the economic environment, which interacts with the program according to economic laws and through economic stimulation. However, the program environment includes also the physical environment which reacts to program measures in a very particular way. But this kind of environment is of a special character because its influence on the program goes mainly through industry and transportation, which interacts with the

physical environment directly. By implementing certain measures we can change this influence. So these relationships can be graphically described by Figure 3:

where E_3 is the physical environment and i is the program level.

The macroeconomic aspects of the energy conservation can be represented by Figure 4. As all the sectors in the economy (in our case subprograms in different sectors) are interrelated, each action in one sector has an influence on others. To manage the program we must take into consideration all these interactions.

The complex approach in the studying of every large-scale program requires not only the distinguishing of the interrelated subsystems but also of the actors involved in program implementation. The main actors of the energy conservation program can be seen from Figures 2 and 4. As the objective formulation for this program is more a political process than an analytical one, in the problem formulation and realization the question of the interrelations inside the government plays one of the most important roles and especially the relations between Administration and Congress, federal and state governments, and the political parties. All the government measures are aimed at the private sector. The essence of these relations will be discussed further. But here it is necessary to point out that the contradiction of interests between private sector and legislative body is one of the main barriers to real progress in the whole energy program.

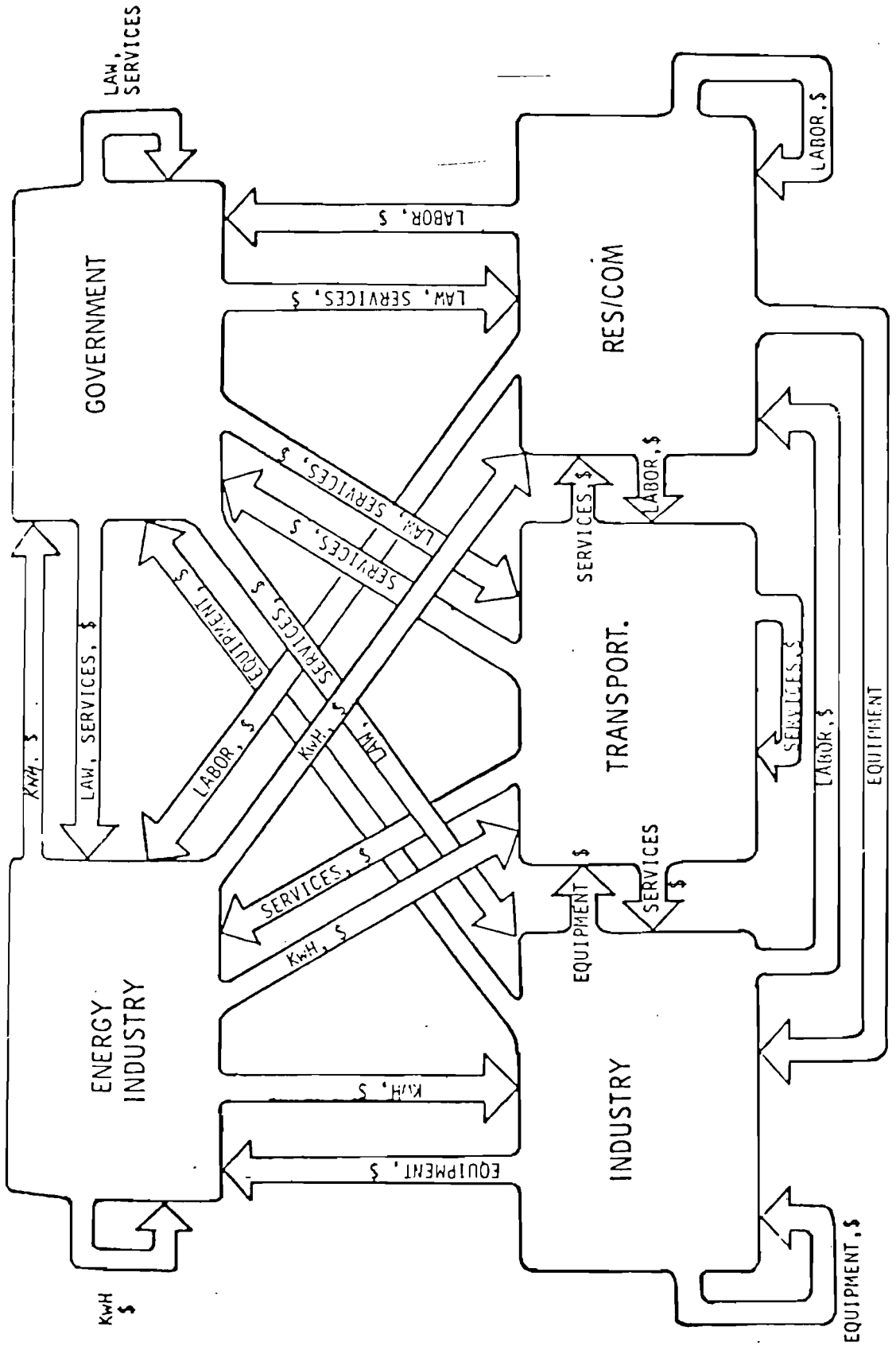

Figure 4. Economic Actions - Impact Flow

Taking into account the place of the energy conservation program in the socio-economic system we can say that from the managerial point of view its realization can be achieved through three kinds of measures:

- requiring only managerial influence,
- requiring legislative influence,
- requiring changes in life style [17,C-10].

The third category of measures lies not only in management but in the whole system of the state regulation of socio-economic processes, and that is why it is the most difficult to achieve.

3. THE SUBPROGRAM OF ENERGY CONSERVATION IN INDUSTRY

3.1 THE CHARACTER OF THE MEASURES

The industrial sector accounts for about 40 percent of the total U.S. energy consumption. About two-thirds of this energy consumption is taken up by six industrial manufacturing groups as follows:

- Primary metal industries,
- Chemicals and allied products,
- Petroleum refining and related industries,
- Paper and allied products,
- Stone, clay, glass, and concrete products,
- Food and kindred products [6,406].

While the industrial sector is much less homogeneous than the other sectors of the economy, the recommendations for energy conservation consist essentially of two items: more efficient heat utilization and more efficient use of material. The program has the following objectives:

- develop economically viable technologies for reducing energy consumption in industry,
- accelerate industrial initiatives and promote the acceptance of new technologies,
- establish national technical leadership to guide the development and implementation of economically viable techniques for improving the efficiency of industrial processes [5,167].

The conservation programs of the federal government embrace a number of activities with the common aim of accelerating the process within the private sector by which energy use will become more efficient. This includes:

(1) programs whose purpose is to speed the introduction of equipment which uses less energy,

(2) programs to allow the public to make more informal judgments regarding their purchases and their use of energy,

(3) programs aimed at stimulating efficient energy use through such means as incentives, regulations, and loans [5,153].

To implement these programs a set of issues should be taken into consideration:

- interactions with foreign economies,
- legislative activity of the federal government and states,
- existing energy conservation efforts, economic, technical and social, within the legislative and executive branches of state and federal government,

- the interests of the different groups and sectors,
- "life style" changes for any anticipated energy conservation action,
- capital requirements and financial feasibility of actions anticipated,
- availability of the energy resources,
- evaluation of net energy savings,
- environmental impacts [4,88-89].

We can distinguish two groups of industries for which the approach to energy conservation will to some extend be different. The first group is energy producers, the second energy consumers. The second group is the main object for energy conservation. Conservation in these industries is achieved through three kinds of actions:

- increased efficiency of fuel combustion,
- improvements in the production processes,
- better exploitation of buildings.

Industry energy conservation is being executed by evaluation of the processes and the equipment and technologies used, by further evaluation of selected energy-intensive industrial processes to determine prime opportunities for energy conservation, by comparison of the alternative processes and energy sources. The difficulty is that we must use different approaches to energy conservation for different processes and industries. The general approach to reducing energy consumption in the industrial sector through federal efforts involves systems analysis of processes, unit operations, and technologies to determine major energy losses and hence "targets of opportunity" for energy conservation. Schematically the process of choosing new technologies can be

represented by Figure 5:

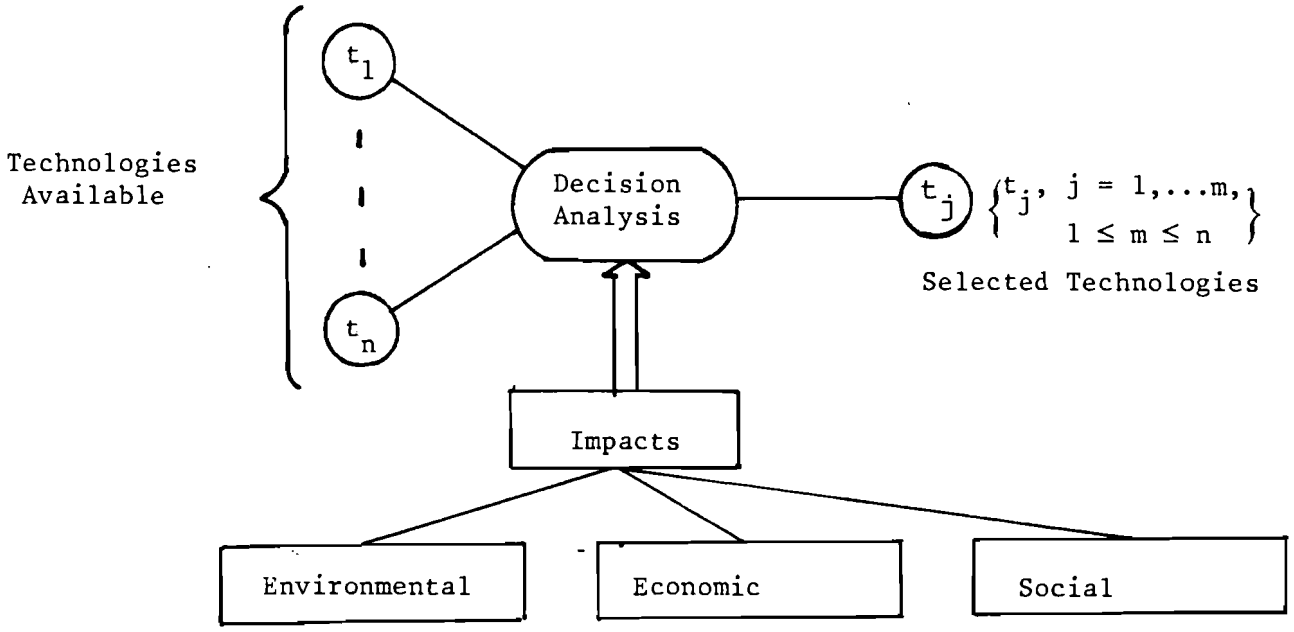

Figure 5. Selection of technologies for energy conservation.

Source: On the base of ERDA 76-1 II, 167.

In the realization of R & D programs, the crucial point is the character of the federal government-business interrelations. The mechanism of the governmental influence on energy conservation program implementation consists of three parts:

- macroeconomic and energy policy,
- industrial policy,
- local policy.

Concrete actions are implemented within one of these levels.

The federal government conducts those RD & D programs for which the expected benefits would spread widely, but which the privave sector would normally not pursue on its own because of economic, regulatory or other reasons. The federal program focuses on two areas:

(1) increasing the efficiency of commonly exployed unit processes and

(1) increasing the efficiency of commonly employed unit processes and

(2) improving the efficiency of energy-intensive processes in major energy consumption industries.

The federal role in this program is as follows:

- fund the development of basic technologies that are promising but not yet close to commercialization,
- encourage technical information exchange within and across industries,
- support materials and process R & D which reduces the total energy required to provide final products,
- establish voluntary targets of conservation for the most energy-intensive industries,
- develop voluntary energy efficiency targets for process equipment,
- develop legislative and other incentives for the implementation of industrial energy conservation technologies, where required [5,167-168].

3.2 THE ROLE AND PLACE OF TECHNOLOGIES

Speaking about the energy conservation program we can define it as a techno-socio-economic system. However, technologies by themselves cannot solve the problem. We need a special economic organizational mechanism for implementing these technologies. In this sense we can describe our program as consisting of three structural components:

(1) technical means (equipment, production processes, computers, etc.), which are called HARDWARE,

(2) methodology for implementation of new technologies, basic research in energy conservation, analytical methods for setting standards etc.--SOFTWARE,

(3) corresponding organizational mechanism for implementation, etc., which are called ORGWARE. By its definition ORGWARE "is a set of organizational arrangements specially designed and integrated using human, institutional, and technical factors to support appropriate interaction of the technology and external systems" [8,8].

So for this kind of program we can use SIOT approach (systems-integrated organized technology) which studies the program from two points of view:

(a) as a certain management system,

(b) as a system for the implementation of the new technologies [8;9].

The interaction of three system components can be represented by Figure 6.

3.3 MANAGEMENT SYSTEM AT THE FEDERAL LEVEL

Before creating the Department of Energy in 1977, the primary role in energy conservation management in industry was played by three federal government agencies: the Department of Commerce (DOC), ERDA, and the Federal Energy Administration (FEA). DOC provided management and engineering information to assist industry in implementing energy conservation programs in the form of engineering guidebooks, technical papers and reports.

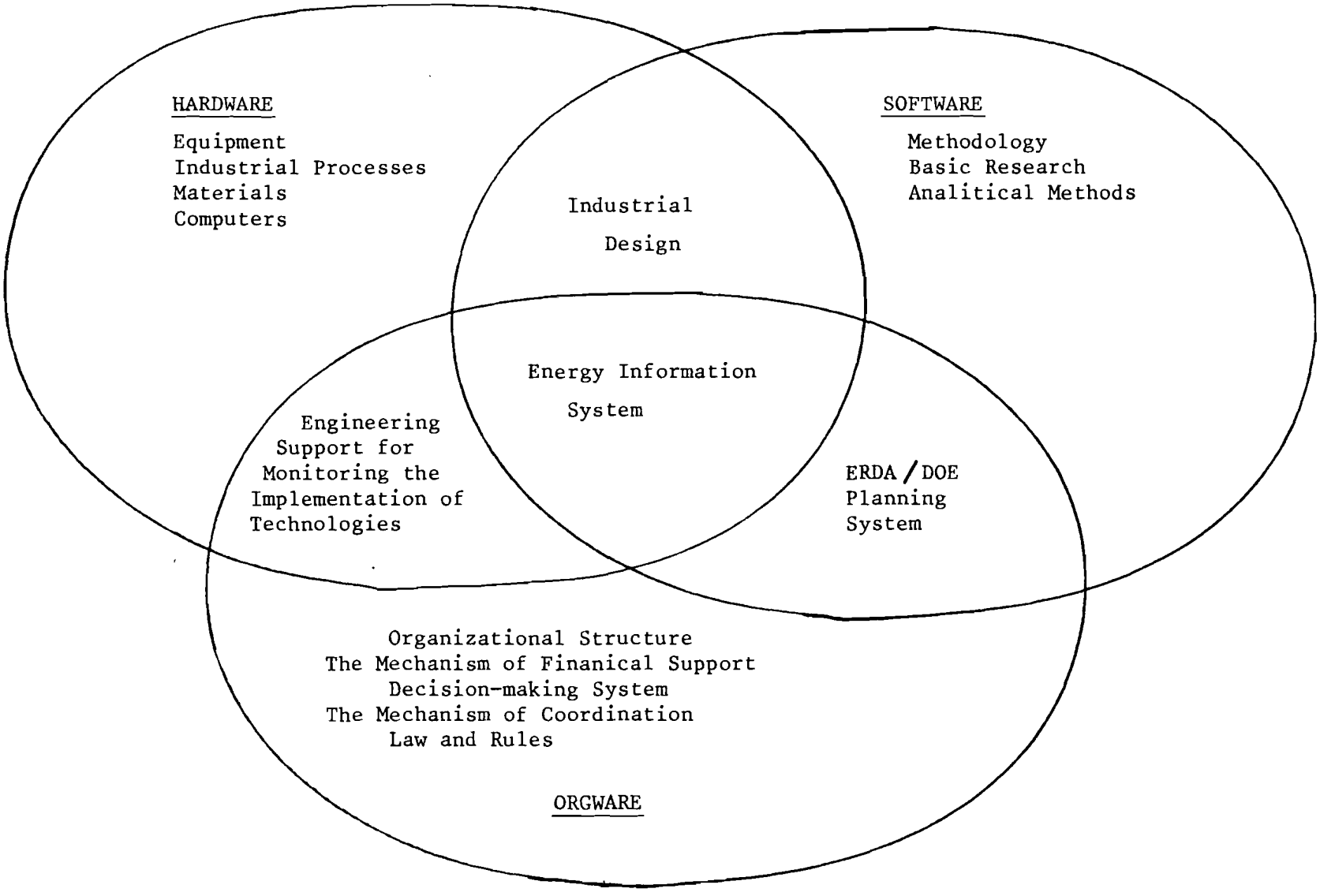

Figure 6. HARDWARE, SOFTWARE, ORGWARE Interactions in Energy Conservations Program

Source: based on 8, 11

Industry studies had also been undertaken to identify and quality the energy requirements resulting from environmental controls for energy requirements resulting from environmental controls for the various union processes in the respective industries. Besides this, DOC developed jointly with FEA an industrial energy conservation and reporting program in which over 50 trade associations representing 30 distinct industry groups participated. The firms involved in these industries accounted for about 70% of the total energy consumed in the industrial sectors of the economy [6,88].

Other documents were also developed jointly with FEA. Among them the most important was "Energy Conservation Program Guide for Industry and Commerce" (EPIC) [14]. The development of this project was done in cooperation with other federal agencies (primarily with Environmental Protection Agency and Occupational Safety and Health Administration).

In its activity DOC has contacts with different industrial organizations (Electric Power Research Institute, Pennsylvania Power and Light Company, Rochester Gas and Electric Company and others) to develop specific manuals for energy conservation based on EPIC [6,94-95].

ERDA's role in this program was to coordinate and lead the federal program for R & D on new technologies for conserving energy in industry. The subprograms were aimed at:

- unit operations and equipment efficiency,
- process analysis and modifications: examination of energy balances and material flow in high energy consumption industries and the examination of techniques for optimizing such processes for minimum energy consumption,

- evaluation of the alternative fuel, materials and processes,
- industrial information and technology transfer [5,169-170].

ERDA Plan foresaw the implementation of formal mechanisms or operating relationships to assure:

- location of programs within ERDA to maximize chances for an integrated systems approach to solving problems;
- coordination of programs with the various federal agencies, and state and local governments involved in energy conservation work; and
- integration of foreign energy conservation RD & D into domestic planning [7,147].

FEA also developed a set of programs and among them the most important was "Voluntary Industrial Energy Conservation Program" carried out in conjunction with DOC which involved over 200 firms and 20 trade associations of the 10 most energy-intensive industries. This program included energy-efficiency goals and a method of reporting progress toward them, generally via a trade association. FEA also carried out an active program of analysis and evaluation of operational and technical conservation options and opportunities. It developed and disseminated this information to industry via publications and other means. Technology transfer included industry-specific efforts and equipment/process-specific efforts [10,28].

The sequence of the actions for this program looks the following way (Figure 7):

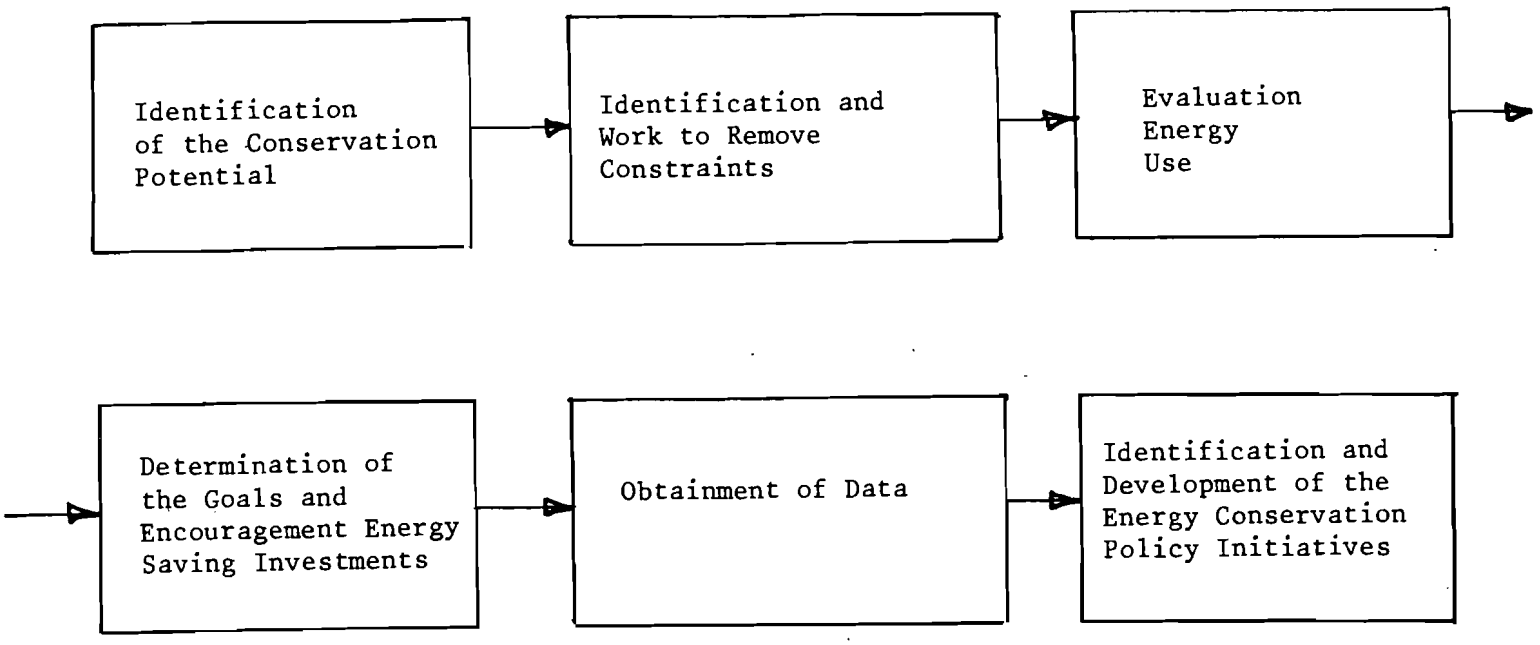

Figure 7. The sequence of the actions for policy identification.

Source: Based on [5,171].

The initiatives developed by FEA can be divided in the following way:

- industry-by-industry initiatives,
- industry specific initiatives,
- equipment/process - specific initiatives
- company-specific initiatives,
- legislated initiatives.

3.4 THE ROLE OF THE STATES IN PROGRAM IMPLEMENTATION

The general approach to program management is the same on this level. However, the state level has some differences from federal level. First we have a different program environment: here the program is more concrete because on the one hand it is connected with a definite regional industry and with definite enterprises and on the other hand with the concrete social environment of a given region. It should be pointed out that the

interaction of this social environment with a program level ($E_1 \leftrightarrow P_2$) is much more intensive for nonindustrial subprograms (conservation in buildings, in transportation, etc.). In order to influence business the state government uses the system of financial, taxation, and demonstration actions. However, the acceptability of these actions depends greatly on cost-effectiveness analysis in firms and profitability. Potential energy-conserving measures are judged on the basis of their effect on costs of production and return on investment. Alternative processes almost always involve large changeover costs, sometimes to the extent of complete replacement of a plant. So process changes are certainly carefully scrutinized by industry. Each industry, and to some extent, each plant is a unique situation and this imposes an additional difficulty on government actions. The potential role of state government policies in this type of situation is more limited than in the case of residential, transportation, or commercial building uses of energy.

Given the array of policy approaches available to them, the states must decide which policies to use and the level at which to set them. The states' choices are in part constrained by their limited jurisdictions. States have no power to require that business, individuals or public agencies in other states conform to any particular policy. Thus, no state can unilaterally set the price of a good that is freely traded among other states not having the same regulation [11,84]. The federal government, on the other hand, has jurisdiction that extends across all states and thus goods cannot "escape" to bordering states with more attractive prices. That is why the federal government has much more

possibilities to implement energy conservation measures.

The states' powers to regulate energy-consuming or conserving standards are also restricted due to their limited jurisdiction. The states' limited jurisdiction is also a factor in discouraging individual states from financing research investigations which will pay off, if successful, for all the states. In this sense they are also dependent somehow on federal government financial programs, because their policies in energy conservation are limited by their financial resources.

Nevertheless, a great number of states have a broad system of governmental measures in energy conservation. They use different planning systems, information systems and analytical methods. The broadest systems of this kind were developed in California, Maryland, Michigan, Minnesota, New England region, Northwest region, Ohio, Texas and Wisconsin [13].

The programs, like energy conservation in industry, are both national and regional (taking into account the importance of the regional actions). This causes the necessity for federal-state interaction in their implementation. All the primary federal government agencies connected with energy conservation have a special department for regional affairs. They also have a well developed regional structure and a set of regional offices for implementation of the program and contact with state and local authorities. Namely, the Northwest Energy Policy Project (NEPP) which has financial support from the Pacific Northwest Regional Commission, has straight contacts with the Bonneville Power Administration (BPA) of the U.S. Department of the Interior, the Economic Research Service of the U.S. Department of Agriculture,

and the National Bureau of Standards of the U.S. Department of Commerce. For example, BPA contributes in this project by transportation services, clerical support, reproduction and graphic services, communication services and computer services [13,24]. The universities of the region and other organizations provide the scientific support for the project, so the program realization at the regional level goes through interactions of different federal and regional agencies, business and scientific organizations.

4. CONCLUSIONS

So here we have studied in general the structure and interactions in the energy conservation program. This program forms a complicated techno-socio-economic system with various subsystems and actors involved. It is a highly dynamic system due to the character of these interactions. So it imposes certain specific requirements for the management system which must be carefully studied. The present analysis seems to be useful in two senses:

First, it proves, to some extent, methodology developed in IIASA for studying large-scale programs, but applies it to a different kind of program, and

Second, it reveals the general factors that can influence the program effectiveness:

- the precise goal-setting,
- the correspondence between organizational mechanism and objectives set,
- the correspondence between actions done and the objectives set.

In the present study the problem of program evaluation has not been studied although it is one of the most complex parts of program management and it must be studied in detail separately, both theoretically and applied to a certain program.

Appendix I

U.S. FEDERAL GOVERNMENT ENERGY ORGANIZATION

A HISTORICAL VIEW OF THE NEW AGENCIES

Date	Agency	Functions
1971-1972	1. Office of Emergency Preparedness (OEP)	Oil import policy
	2. Oil Policy Committee	From OEP and Department of Interior
18 April 1973	1. Special Committee on Energy, "Committee of Three"	Consultant body to advise President
29 June 1973	2. Energy Policy Office	Instead of Special Committee on Energy and Oil Policy Committee
	3. Energy Policy Council	
October 1973	Arab oil embargo	
4 December 1973	Federal Energy Office (FEO) instead of Energy Policy Office	Part of the functions from Interior, price control authority from Cost of Living Council, petroleum allocation
May 1974	1. Federal Energy Administration	Administration of the policy set by COE
June	FEO abolished	Its functions transferred to FEA
	2. Committee on Energy (COE)	Coordination of energy policy within the executive branch

Appendix 1 (continued)

Date	Agency	Functions
11 October 1974	Energy Resources Council	Instead of the Committee on Energy
November 1974	"Project Independence Report"	
January 1975	President Ford proposal for the creation of an Energy Independence Authority	To finance high-risk investment in energy production and conservation
Fall 1974	1. Energy Research and Development	Coordination in energy R & D
19 January 1975	Administration	
	2. Nuclear Regulatory Commission	Regulatory responsibilities from Atomic Energy Commission
August-September 1977	Department of Energy	Coordination and administration of the energy functions of the Federal Government

Appendix 2

EXISTING U.S. FEDERAL GOVERNMENT ENERGY ORGANIZATIONS BEFORE 1977

I. EXECUTIVE BRANCH ENERGY ORGANIZATION.

1. Energy Resources Council
2. Office of Management and Budget

Cabinet Departments

1.	Department of Interior	primary role
2.	Department of Transportation	
3.	Department of Treasury	
4.	Department of Defence	
5.	Department of Agriculture	secondary role
6.	Department of Justice	
7.	Department of State	
8.	Department of Commerce	

Independent Agencies

1.	Federal Energy Administration	
2.	ERDA	
3.	NRC (Nuclear Regulatory Commission)	primary role
4.	Environmental Protection Agency	
5.	Federal Power Commission	
6.	Tennessee Valley Authority	
7.	General Services Administration	
8.	Interstate Commerce Commission	
9.	Council of Economic Advisers	secondary role
10.	Federal Trade Commission	
11.	National Science Foundation	

II. CONGRESSIONAL ENERGY ORGANIZATION

Senate Committees

1. Aeronautical and Space Sciences
2. Agriculture and Forestry
3. Appropriations
4. Banking, Housing, and Urban Affairs
5. Commerce
6. Finance
7. Foreign Relations
8. Government Operations
9. Interior and Insular Affairs
10. Judiciary
11. Labor and Public Welfare
12. Public Works
13. Rules and Administration

Appendix 2 (continued)

The House Committees

1. Agriculture
2. Appropriations
3. Armed Services
4. Banking and Currency
5. Education and Labor
6. Foreign Affairs
7. Government Operations
8. House Administration
9. Interior and Insular Affairs
10. Interstate and Foreign Commerce
11. Judiciary
12. Merchant Marine and Fisheries
13. Post Office and Civil Services
14. Public Works
15. Rules
16. Science and Astronautics
17. Ways and Means

REFERENCES

[1] *The Bratsk-Ilimsk Territorial Production Complex.* Proceedings of the Second IIASA Conference on Case Studies of Large-Scale Planning Projects. International Institute for Applied Systems Analysis, Laxenburg, Austria, 1977.

[2] *The Bratsk-Ilimsk Territorial Production Complex: A Field Study Report.* Ed., H. Knop and A. Straszak, Int. Inst. Appl. Syst. Anal., Laxenburg, Austria, 1977.

[3] Davies, C., et al., Research Memorandum, Int. Inst. Appl. Syst. Anal., Laxenburg, Austria, 1977.

[4] *Energy Conservation: A National Forum*, Fort Lauderdale, Florida, 1-3 December 1975.

[5] *A National Plan for Energy Research, Development and Demonstration: Creating Energy Choices for the Future*, ERDA, 76-1, II, 1976.

[6] *Industrial Energy Conservation Act of 1975.* Hearings before the Subcommittee on Energy Research, Development and Demonstration of the Committee on Science and Technology, U.S. House of Representatives, 94th Congress, 9-11 September 1975.

[7] *Comparative Analysis of the 1976 ERDA Plan and Program*, Office of Technology Assessment. May 1976.

[8] Dobrov, G.M., *The Strategy for Organized Technology in the Light of HARD-, SOFT-, and ORG-WARE Interaction*, Int. Inst. Appl. Syst. Anal., Laxenburg, Austria, 1978.

[9] Dobrov, G.M., et al., *Toward Systems-Integrated Organized Technology; HARDWARE, SOFTWARE, ORGWARE Interaction*, Inst. Inst. Appl. Syst. Anal., Laxenburg, Austria, 1978.

[10] Federal Energy Administation. *Annual Report*, 1975-1976.

[11] Northwest Energy Policy Project. *Energy Conservation Policy Evaluation: Final Report*, I, Environmental Research Center, Washington State University, Pullman, Washington, 1977.

[12] *The Energy Daily*, Supplement to 5, 179, 14 September 1977.

[13] *A Review of Leading State Efforts in Energy Data and Modeling*, Illinois Department of Business and Economic Development, May 1976.

[14] *Energy Conservation Program Guide for Industry and Commerce* (EPIC), U.S. Department of Commerce/National Bureau of Standards in cooperation with Federal Energy Administration, 1974.

[15] *Systems Analysis Applications to Complex Programs*, ed. K. Cichocki and A. Straszak, Pergamon Press, 1976.

[16] *Energy Supply and Government Policy*, ed. R.J. Kalter and W.A. Vogely, Cornell University Press, 1976.

[17] Armstrong, J.E., and W.W. Harman, *Plausibility of a Restricted Energy Use Scenario*, Stanford Research Institute, Menlo Park, California, 1975.