

MASTER

FACTORS THAT INFLUENCE THE ACCEPTANCE OF
INTEGRATED COMMUNITY ENERGY SYSTEMS

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FOREWORDENERGY CONSERVATION VIA
INTEGRATED COMMUNITY ENERGY SYSTEMS

This report is part of a series of studies designed to analyze the commercialization potential of various concepts of community-scale energy systems that have been termed Integrated Community Energy Systems (ICES). The study reported here concerns ways that affected individuals and organizations will respond to proposed ICES development projects. The intent is an initial examination of several institutional sectors that will: (1) anticipate responses that could impede ICES proposals and (2) provide an information base from which strategies to address adverse responses can be formulated.

The Need for Integrated Community Energy Systems

Events of recent years have created public demand at the community as well as the national level for energy supply systems that are energy-conserving, safe, environmentally acceptable, reliable, and "price stable"-- that is, consumers can expect that their energy expenditures will be a relatively constant share of their total budgets. The Integrated Community Energy Systems (ICES) Program of the ERDA Office of Energy Conservation is designed to develop community-scale energy systems with these characteristics. These systems will represent an integration of community design planning and energy technology concepts and will help achieve the national goal of conserving energy, and, in particular, of conserving scarce fuels.

A Definition of "Community"

The definition of "community" as used in the phrase "integrated community energy systems" is: a complex of buildings (and open space that are employed in human activities and that are connected by networks for moving people and their messages, as well as goods and services, to residential, commercial, industrial, agricultural, recreational, or cultural; the "networks" may be transportation routes or modes, pipelines, communications links, telephone or electrical transmission lines, etc. Superimposed on the physical landscape of any community are complex political, social, and economic systems and jurisdictions that determine the types and levels of the community's activities. Thus, a "community" may be as diverse as a municipal or suburban business district, a farm community, or a multiply-zoned Planned Unit Development to name only a few. Furthermore, the ICES Program is conceived for communities in various stages of development in both new and redeveloped areas.

Integrated Community Energy Systems and Their Role in Communities

An integrated community energy system is more than a new hardware system -- although equipment certainly would be part of an ICES. Neither can the concept be limited to simply designing buildings or arranging activities in space. An integrated community energy system would not

necessarily supply only a single service, e.g., electricity, in an energy-conserving fashion, such as by recovering waste heat from the energy system. Rather, the whole ICES concept seeks an optimal combination of all of these dimensions to meet the energy requirements of a particular community. An ICES -- as an investment in integrated human, building, network, and machine systems -- would become an integral part of the larger community providing energy-using services to support the residents' lifestyles in a stable and environmentally sound fashion.

Designs for Energy-Conserving Communities

Energy conservation in a community development can be accomplished by:

1. Reducing or minimizing energy consumption in a development plan via design options linked to existing, conventional energy supply systems. This assumes that development design is independent of the energy supply. Achieving this objective will require:
 - choice of activity (residential, commercial, public, etc.) mix to facilitate the intended community functions,
 - choice of building types and density to achieve energy conservation while meeting the expectations of building users, and
 - careful attention to site planning with sensitivity to local topography and climate and to internal circulation requirements as they affect energy consumption.
2. Designing energy conserving supply systems to meet the demands of a given community. This assumes that the development plan is fixed and merely produces energy demand load profiles and engineering design parameters. Achieving this goal will require:
 - reliable delivery of primary (electrical and thermal) services in an energy-conserving fashion,
 - electrical (or other) grid or non-grid connected systems when appropriate,
 - incorporation of appropriate, ancillary energy-related services, such as solid and liquid waste recovery, wastewater treatment, transportation, and communication, and
 - development and demonstration of new energy-conserving technologies and systems in the community context.

ICES Program Objectives

The major thrust of the ICES Program combines both of the above design options whereby the entire development design, including energy supply, is allowed to vary in a systematic manner to achieve specific design criteria while simultaneously minimizing or reducing energy consumption. In this case, the development plan and energy supply system are designed simultaneously. Achieving this objective will require integration of the various fields of technology, institutions, organizations, and processes that:

- design and build communities and energy systems,
- finance community development and utility services, and
- own, operate, and regulate community development and energy and waste management systems.

Some circumstances exist under which energy or scarce fuels can be conserved within the community structure while simultaneously benefiting all vested interests in community development. That these targets of opportunity exist is implied by recent construction of solid-waste recovery systems used in conjunction with steam or electrical generation facilities in various municipalities throughout the country. Under these conditions, the objective of the ICES program would be to identify those opportunities and to provide the necessary information and technical assistance to bring about implementation.

A second set of circumstances may also exist where energy might be conserved by proposed community energy system development, but not all vested interests would benefit from the venture; in fact, there would be a net cost to some parties. In this case, the classical tradeoff situation would exist whereby some parties would have to be compensated to encourage their support; this would involve a change in public policy, such as a modification of regulatory requirements or a transfer of payments of one form or another. Another major objective of the ICES Program is to identify the costs and benefits of such policies to delineate the high payoff strategies that would bring energy conservation into balance with other social goals.

A third set of circumstances may exist where significant energy saving can be achieved by the application of an emerging, possibly untried technology or a novel synthesis of existing technology. In this case, investment from the private sector may not be readily forthcoming because of the high risks involved. The ICES program would then undertake development and demonstrations programs to prove out these concepts and thus encourage their commercialization.

Finally, the ICES program seeks to integrate and apply emerging technologies within the community context that have been developed within other energy RD&D programs. Simultaneously, ICES seeks to identify specific RD&D objectives for these programs that could further benefit the community energy system concept.

This general definition of objectives for Integrated Community Energy Systems can be understood to apply to such diverse potential recipients as:

- municipalities owning and operating utility systems,
- municipalities served by private utility companies,
- redevelopment projects and new community developments, and
- institutional building complexes and campuses.

Summary

In brief, the ICES Program is intended to identify the opportunities for energy conservation in the community context through analysis, development, and/or demonstration of:

- location and design of buildings, building complexes, and infrastructure links,
- engineering and systems design of existing, emerging, and advanced energy production and delivery technologies and systems,
- regulatory designs for public planning, administration, and regulation of energy-conserving community development and energy services, and
- financial planning for energy-conserving community development and energy supply systems.

1 INTRODUCTION

The commercialization element of the Community Systems Program seeks to facilitate the wide-spread adoption of integrated community design and energy system concepts and technologies. As with any new technology, the rate of adoption will be influenced, not only by technical characteristics, but also by cost performance characteristics, the organization of the market, and institutional factors that might be raised. This report is concerned with establishing a program to deal with potentially serious institutional factors.

The types of communities that are design targets for community systems RD&D outputs are many and varied. The general definition of objectives for integrated community energy systems can be understood to apply to such diverse potential recipients as:

- 1) municipalities owning and operating utility systems,
- 2) municipalities served by private utility companies,
- 3) redevelopment projects and new community developments, and
- 4) institutional building complexes and campuses.

This array of communities represents an equally imposing diversity of market structures and institutional environments that must be studied as part of the commercialization element. One approach to studying institutional factors might be to categorize these markets as succinctly as possible and then catalog for each distinguishable market the impeding factors that might arise because of its special circumstances and mix of institutional actors. It is not clear at the outset of the program, however, that this encyclopedic approach is either feasible or necessary. Considerable effort would be required: (1) to portray accurately each community type and the interactions among participants in its building, and (2) to assess the effects of these interactions on community systems innovations to customary projects. No definitive listing of possible target communities has yet been prepared for the program, but one could almost immediately write down a few dozen distinct community types that should be considered. Large-scale developments for which community systems concepts are appropriate are, in fact, each a unique combination of site, purpose,

physical plan, and institutional context. Exactly how many community types would have to be studied to fill out the catalog of institutional factors is not certain, but the number is large.

The value of a process that can be applied: (1) to define the institutional problems associated with any target community and (2) to determine acceptable solutions to the problems has been recognized. Appendix E contains suggestions for such a process. This kind of process could be the basic mechanism for identifying a compendium of institutional factors, should that subsequently be found desirable. It can also be applied in case studies and demonstration proposals of individual community systems projects. Persons working on this project generally have concluded that the kind of detail represented by certain case studies is needed to assess adequately the relative importances of potential institutional factors; Appendix E describes the process designed primarily for use in case studies.

One of the prerequisites for any application of the process is a thorough background knowledge of the makeup and responsibilities of the major participating institutional sectors. The primary effort in this project was devoted to assembling the background knowledge of institutional sectors involved in an important class of target communities, namely, large-scale private development. Private developers typically operate under severe constraints which they have only limited opportunity to change. Only a few of them will initially be receptive to community systems concepts. Because the total of private building is so large, however, it is essential to address the institutional factors that will confront private developers and try to remove as many barriers as can be justified. Sections 2 and 3 of this report represent an overview of the private development process, the institutional environment surrounding it, and a closer survey of several sectors of the environment. Together they provide an information base for further analyses.

Figure 1.1 illustrates the point of view adopted in our examination of private development. We assume the development firm's backing for a community systems proposal and try to anticipate the responses of other participating market institutions. Naturally, the development firm's actual decisions are not independent of these anticipated responses. To understand how the firm would decide to sponsor energy conserving concepts, a separate project has

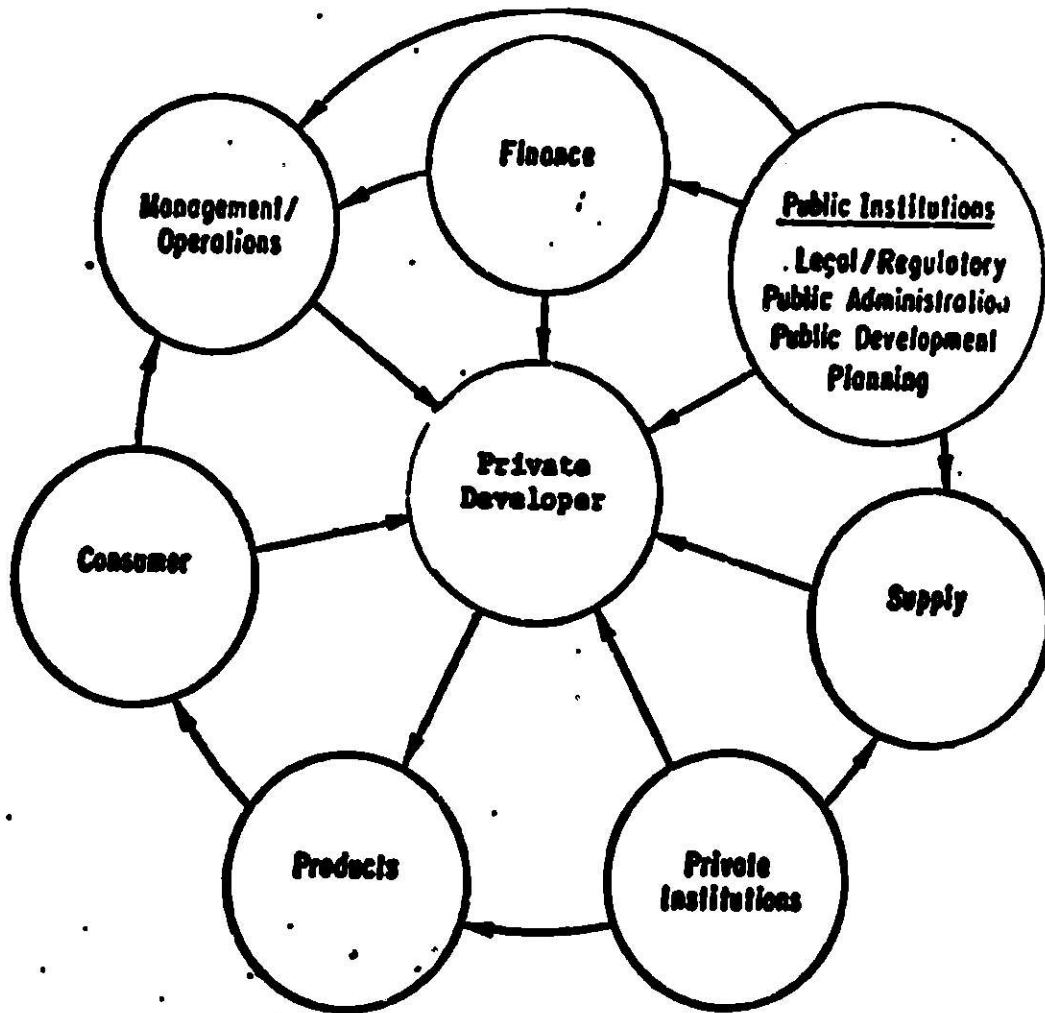


Fig 1.1 Institutional Context for the Development Process

been undertaken to study the criteria a developer would apply in evaluating alternative energy supply systems for a large suburban shopping center. The results of that study are reported elsewhere. In Section 2, the process that is typically followed in producing a large-scale development is outlined as a means of revealing some of the ways that institutional sectors, such as those in Fig. 1.1, impinge on the developer.

From this general overview, Section 3 elaborates on the examination of three of the institutional sectors -- public institutions, private institutions, and consumers. A fourth sector -- financial institutions -- is the subject of another project whose results are reported separately. The research surveys supporting Section 3 provide basic descriptions of the organizations of the sectors and the roles played in the development process. Full-scale community systems development scenarios were not available for simulating institutional responses. However, some present types of development (notably planned unit developments) have features that might be important for energy conservation. Known responses to these developments have been used to infer potential factors affecting community systems proposals. To proceed much farther in the study of institutional factors will require an examination of specific proposals, i.e., case studies, in the manner of the process outlined in Appendix E.

2 A STARTING POINT: THE DEVELOPMENT PROCESS

2.1 PRIVATE DEVELOPMENT

As was explained in the Introduction, the starting point for the studies summarized in this report has been to assume a development firm as the proponent of a community systems project. In subsequent work, this assumption should be subjected to close scrutiny. Is the private developer of large-scale projects more likely to be an innovator -- and thus encounter risks and institutional problems -- than is the public builder of an institutional complex or a publicly regulated utility company? The results from one examination of this question seem to conclude: "it depends." In many instances, the developer himself is unable to alter circumstances (availability and cost of investment capital, consumer tastes, costs of alternative fuels and utility services, etc.) and is in no position to assume avoidable risks. If the developer will also occupy the completed project or at least will own and operate it, his incentives to examine the potentials for energy conservation and to consider an attractive possibility will be measurably increased. It should not be surprising, therefore, that more than one large development firm has expressed an interest in the objectives of the Community Systems Program.

With regard to the study of institutional factors, a second question should be asked about a developer as an innovator. Is the institutional context experienced by a private developer significantly different from that of public or semi-public developers, and if so, what could recommend looking first at the private developer's context? Recognising once more that "private developer" means one thing for speculative development and something else for owner-occupied development, the answer is still yes to the first part of the question. The mechanisms for raising capital, the regulations that must be met, and the elements that go into a determination of feasibility are examples of the difference between private and other, more public, developers. The choice of which developer type to examine first is somewhat arbitrary, but several justifications for starting with private developers can be offered. Private development accounts for most of the new construction in this country, e.g., approximately 70% between 1960 and 1975. Because an objective of the Community Systems Program is to address problems in a manner that will be meaningful to the widest range of ultimate implementers, the problems associated with private development of community systems cannot be ignored. Although

innovation in the private sector will be difficult and the number of firms large enough to be capable of developing community systems projects is limited, we need to develop better estimates of realistic potentials for commercialization there. Furthermore, the variety of organizations and constraints that cause problems for even the largest private developers appears to make their institutional context an ideal one to use in establishing and testing a framework for studying institutional factors.

2.2 OVERVIEW OF THE DEVELOPMENT PROCESS

Appendix A of this report is an overview of the process by which large-scale development is typically carried out. The overview is based on a chronology of activities that begins with the developer's tentative formulation of alternative investment opportunities and extends to the operation and maintenance of the completed project. From this chronology, we can begin to draw some insights concerning the roles of various organizations in the process. The customary interactions between the developer and other responsible organizations are determined by the requirements of the development process and the objectives and policies of the organizations. This network of interactions, mediated by the development process, is what is meant by the private developer's institutional context. The two primary goals of the overview, therefore, are to:

1. identify the organizations that participate in the development process (at other places in this report these might be designated as actors and, in closely related groupings, as institutional sectors); and
2. describe how the organizations interact during the development process.

Furthermore, it may be useful to:

3. identify some choices that affect the energy consumption of the community under development; and
4. form some general hypotheses about the responses of the participating organizations to energy conserving development proposals.

The intent of this overview as a *framework* to direct us toward more detailed studies must be emphasized. Conclusions from it pertaining to items 1 and 3 will be given next. The following section will present results for items 2 and 4 from closer examinations of several important institutional sectors.

2.2.1 Institutional Sectors

Any study of the development industry soon reveals the existing organizational complexity. Two characteristics of the industry are a tendency of firms: (1) to be regionally oriented, and (2) to specialize in only a few of the industry's submarkets, the latter resulting in associations of firms such as the National Association of Home Builders (NAHB) in the residential submarket. In numbers of firms, the residential submarket is dominated by smaller builders, with as many as 2/3 of the membership of the NAHB constructing fewer than 25 units a year in 1969. Although these small builders accounted for only 17% of all units produced, firms that are defined as large in the housing industry (i.e., producing more than about 200 units per year) generally are tiny in comparison with most industrial establishments. The 50 largest firms built about 15% of the total residential market in the late 1960's, a time when the larger firms were producing an increasing share of the units. Whether this trend toward concentration of residential construction in fewer large firms is continuing, it seems clear that only a small fraction of the new housing will be built by firms large (and secure) enough to be initially receptive to significant innovation. The distribution of firms by size and portion of the market may be different in other development submarkets, but the same conclusion regarding innovation is likely to apply there also.

Another important characteristic of the development industry is its horizontal stratification and, further, a dependence on "outsiders." Seldom does one find a firm in the industry that produces construction materials, undertakes the development of land and the building of structures, and then markets the completed buildings. Rather, these functions more often are carried out by separate firms brought together, however loosely, in a building project by the developer who is its motivating force and primary risk taker.

The developer traditionally has operated with small amounts of equity capital, relying primarily on borrowed capital. The effect is to thrust lending institutions forward as highly important decision makers in the development process. Their criteria for judging the financial soundness of proposed developments greatly influence which ones actually are undertaken. Each development becomes a feature of the landscape and a functioning part of the community within which it is located. Because of this local impact, governments have asserted some measure of control to ensure that public health, safety,

and general welfare are not jeopardized. This control has taken the form of zoning and subdivision regulations (based on a community growth plan), building codes, and, more recently, environmental regulations. Much of the control has been delegated to local governments, and their review of proposed developments forms another important "outside" influence on what is constructed.

Manufacturers and their sales representatives, land owners, consulting architects, engineers and planners, contractors and subcontractors, banks and other lending institutions, public planning, inspection, and regulatory agencies, and buyers or renters of the completed development project are some of the more obvious roles that must be filled during the development process. A sizable body of literature describing the various developmental roles has been built up. To make a study of the many possible roles manageable, we have chosen six institutional sectors that seem to encompass the more important non-developer roles in the process. These six sectors are listed in Table 2.1. Decisions and actions made within these sectors might have determining influences on the developer's willingness and ability to carry out a project.

Before describing some of the factors that could be important, we should point out two features of a model of the development process that emphasizes various roles. First, a role is not independent of the actor filling it. An obvious case in point is the effect on the developer role when a public housing authority, rather than a merchant builder, is the developer of a residential community. This is another aspect of the need to have a fully specified case study -- including the projects and actors -- before definite conclusions about institutional responses can be reached. The second point is the temporal dimension of the development process. The kind of large-scale development project that is of interest to the Community Systems Program normally takes several years from initial concept to occupancy. In Appendix A, the time dimension has been indicated by the admittedly gross oversimplification of dividing the development process into several major phases. Through this expedient, we can display the way different roles come into play as the process is carried forward. In Table 2.2, the individual roles within the six institutional sectors are indicated for five development phases. In an actual development project, the entrances and exits must be timely.

TABLE 2.1 Institutional Sectors in the Development Process

- I. Financial
 - 1. Financing
 - 2. Cost
 - 3. Regulatory

- II. Public Institutional
 - 1. Local Planning
 - 2. Administration
 - 3. Regulatory

- III. Private Institutional
 - 1. Appraisal Practices
 - 2. Building Codes
 - 3. Labor Unions

- IV. Consumer Response

- V. Supply
 - 1. Land
 - 2. Materials/Equipment

- VI. Management/Operations

	<u>Feasibility Assessment</u>	<u>Pre-Construction/ Pre-Development Planning</u>	<u>Construction</u>	<u>Sales and Occupancy</u>	<u>Management and Operations</u>
<u>Development Team</u>	Developer Planners and Consultants Architects and Engineers Lawyers Title Companies Soil Tests Market Research Sales and Management Agents	Developer Planners and Consultants Architects and Engineers Lawyers Title Companies Surveyor Pre-Leasing and Sales	Developer Architects and Engineers Contractors Subcontractors	Developer Lawyers Title Companies Marketing Consultants Sales Agents	
<u>Financial Institutions</u>		Lending Institutions FHA, VA, or Private Mortgage Insurance Companies	Lending Institutions	Lending Institutions FHA, VA, or Private Mortgage Insurance Companies	Lending Institutions
<u>Public Institutions</u>	Zoning and Planning Officials Annexation Processes	Zoning and Planning Officials Sanitary Districts School Boards Fire Districts	Building Code Officials Health Code Officials		Zoning and Building Officials Tax Assessors
<u>Private Institutions</u>			Craftsmen and Their Unions Insurance Companies		Repairmen, Craftsmen and Their Unions Insurance Companies
<u>Consumer</u>				Owners Tenants	Owners Tenants
<u>Supply</u>	Land Owners	Land Owners Real Estate Brokers	Materials/Equipment Manufacturers and Distributors	Real Estate Brokers	Materials/Equipment Manufacturers and Distributors
<u>Management/Operations</u>					Property Management Firms Utility Companies Maintenance Firms Architects and Engineers Contractors Subcontractors

TABLE 2.2 Institutional Roles Filled During Several Development Process Phases

In the financial sector several potentially important factors can be suggested for more detailed examination. An area of concern is the effect that investments in community systems projects might have on a firm's financial position. The attitudes of the financial community toward the required rates of return and the applicability of various financing instruments may alter the cost of capital for such projects. Because the community systems projects are more untried, the required rates of return are likely to be higher than for conventional developments. Some forms of risk-sharing by federal and/or state loan guarantees may be critical to reduce the greater risk perceived by lending institutions.

Perceived risks are an outgrowth of the uncertainty of costs for untried developments. If costs are demonstrated to be competitive, non-economic and indirect cost factors will be under strong pressure to yield to the adoption of community systems concepts. Cost in a development project has many components, as indicated in Table 2.3, and cash flow and rate of return analyses should anticipate as many of these components as possible. Demonstrating that a community systems project can theoretically compete and that comparative costs throughout the commercial life of the project are competitive are two separate matters. For example, the project may introduce new legal requirements or operational difficulties over and above what the developer normally encounters. Even if the costs of these difficulties are small in terms of percentage of total project costs, they may result in a resistance to market entry if the developer is unsure of their full implications.

The status of the project in relation to utility regulations is an example of legal requirements that can present the developer with a set of unfamiliar and difficult conditions. If the handling of energy services within the project would bring it under the jurisdiction of the state public utility commission, regulations regarding franchise requirements, rate structures, rate bases, etc., would have to be satisfied. The success of the project would require a favorable attitude by rate commissions. Furthermore, the proposal for a community systems project in a utility service area might lead to jurisdictional disputes among utilities.

Institutional factors for the next three sectors in Table 2.1 -- public institutional, private institutional, and consumer response factors -- are covered in some detail in Appendices B through D and are summarized in the

TABLE 2.3 Cost Components in the Development Process

I. Feasibility and Assessment

Pre-engineering

- Financial Assessment
- Market Assessment
- Legal

II. Pre-construction

**Land Option
Engineering Design
Legal**

- Government Review and Approval Process
- Prepare Bid Package and Contracts
- Loan Guarantees

Financial Instruments

- Land Purchase
- Construction
- Development (Mortgages)

Preliminary Marketing

III. Construction

**Management (General Contractor)
Subcontractors
Material Supplies
Inspections (Delay) and Approvals
Insurance
Training
Equipment Supplies and Acceptance Testing**

IV. Sales and Occupancy

**Marketing Consultants
Legal
Title Companies
Real Estate Brokers
Mortgage Insurance
Finance**

TABLE 2.3 Cost Components in the Development Process (Cont.)

V. Management, Operations, Maintenance

Labor

- Administration (Management, Accounting, Marketing, Personnel, Training, Planning, Legal, Community Relations, and Purchasing)
- Operation
- Maintenance

Maintenance

- Equipment Replacement
- Frequency of Repair
- Backup Systems

Finance

- Debt Service
- Debt Retirement
- Insurance

Materials and Supplies

- Fuel
- Waste Management
- Environmental Control

next section. Factors that are associated with supply of land and materials or equipment are perhaps of less overall importance than the financial factors; however, in particular circumstances, they could be crucial. Relatively few sites in a metropolitan area might be amenable to the energy-conserving design options discussed in Appendix B and also be advantageously located. Existing infrastructure at sites might be incompatible with optimum community design. A potentially important factor related to the supply of materials and equipment is uncertainty in the cost and timely availability of new and/or specialized materials and components. Uncertainty in supply is just one more risk that developers can avoid by confining their activities to "safe," conventional projects.

Selected factors pertaining to management and operation of a completed community systems project could be significant. For example, questions of stand-by service arrangements during prolonged outages must be resolved. The high emphasis on cost factors is likely to carry through to the cost and availability of resources needed during operation -- resources such as trained personnel, repair skills, parts, and equipment. If widespread deployment of community systems concepts is to be achieved, it will be necessary to develop management, operations, and maintenance systems and procedures that are designed to reduce the costs and enhance the reliability of the systems for smaller-scale public and private applications.

2.2.2 Energy-Conserving Development Decisions

The energy consumption of a community is a function of its design and the way it is used. To a significant extent, the use is predetermined by the design. Therefore, the most important decisions about energy conservation are the decisions made during the design of the community, and these are the responsibility of the developer. Other participants in the development process do have an influence, but their influence is largely in the nature of constraints and opportunities presented to the developer.

In the Community Systems Program, design of the community has been separated into two elements: one part can be summarized as site planning and the other is concerned with the design of energy supply and distribution systems to service the community. In both cases, the customary design procedures are to be adapted for a goal of reduced energy consumption, incorpor-

ating whatever new concepts and technologies will facilitate reaching the goal. After a site and basic community function (e.g., new-town-in-town, civic center, industrial park) have been selected, site planning (in its broadest sense) includes tasks such as the following:

1. choice of mix of activities (or land uses -- residential, commercial, public, etc.) to facilitate the intended community function;
2. choice of building types and density to achieve energy conservation while meeting the expectations of building users; and
3. careful attention to site planning (physical configuration of the community, i.e., the layout and orientation of structures) with sensitivity to local topography and climate and to internal circulation requirements as they affect energy consumption;

The complementary activity of energy systems design includes:

1. design of integrated service conversion and delivery systems and system control strategies to match the needs of specified community designs with enhanced efficiency and decreased dependence on scarce, non-renewable fuels;
2. evaluation to demonstrate that cost, reliability, safety, and environmental criteria are met; and
3. incorporation of advancing technologies and concepts whenever it would help to reach the design goals.

In the chronology of the development process in Appendix A, these design choices are made in the two preconstruction phases of the process. In the feasibility assessment phase, the developer evaluates alternative sites and community development opportunities. Energy considerations historically have not been an important consideration at this stage, because development usually takes place in an area served by a utility which has the capacity to supply the project. Early planning does have energy implications, however. The locational decision has access as one of its determinants which is readily translated into the level of transportation services and, hence, transportation energy required. Because it will be one of the elements of the urban form that

structures future locational decisions, the location of this project will have continuing impact on the changes in transportation energy consumption for the region. Even in its most rudimentary form, the absorption schedule also has implications for energy consumption. For a planned unit development, the basic energy consumption patterns will be determined by the mix of dwelling units, the level of shopping opportunities to be provided, and the tentative determinations of overall development density and internal variations in density (i.e., clustering). More explicit later efforts at reduction in energy consumption through optimization of the urban design and technological facilities of the development will work from the baselines set by these early decisions.

The next phase, pre-construction and pre-development planning is detailed in Appendix A. In this phase of the development process major decisions determining energy consumption are made. The design of the structures, their operating systems, and their siting within the development are central concerns during this phase, and each has an effect on the energy ultimately consumed in the development. Systems for meeting end-use energy demands and for supplying the overall energy requirements are chosen on the basis of anticipated use patterns, required systems reliability, equipment costs, and operating costs. In the balance that is struck among all the factors contributing to the evaluation of alternative designs, energy consumption has, until quite recently, been given a relatively low priority. The developer's understanding of the response that the designs will elicit from consumers, public review bodies, and financial institutions is added, in perhaps a more intuitive fashion, to his overall evaluations of them. The degree of importance attached by a developer to these external responses is not always clear, but obvious signals from the groups regarding their probable response to innovations for energy conservation certainly will not be ignored.

These design choices and several other direct determinants of community energy consumption are listed in Table 2.4. Physical characteristics that have energy consequences and practices or behavior affecting the use of the community make up the list.

Some institutional roles in the development process have a direct influence on the developer's choices for one or more of these determinants. This is particularly true for the local zoning and subdivision regulations

TABLE 2.4. Community Design and Use Determinants of Energy Consumption

Site (Location, Climate, Topography)
Access
Activity Mix
Size (Area, Number of Buildings, Level of Activity)
Building Density
Building Types
Site Plan
Internal Circulation
Energy Conversion Systems
Distribution Networks
Building Systems
Construction Practices
Ownership
Operating Procedures
Maintenance Schedules
End-Use Behavior

which have the expressed purpose of establishing review and control over many elements of site planning. The same is true for the effect of building codes on individual structures. These influences are covered at some length in Appendices B and C and are summarized in the next section. In many respects, the traditional goal of these regulations -- in effect, the prevention of undesirable impacts -- is not in conflict with energy conserving community design; however, in their present form, the regulations might not accommodate some of the more promising design options.

In other cases, the influence is considerably less direct. For example, in the financial sector lending institutions are not usually directly involved in the design of the community. Their evaluation of the community's feasibility is sensitive to the implications of its design, but the response does not take the form of control over some of the developer's design options. The same may be true for many governmental regulations not related to local land-use planning. State regulations governing the operations of public utilities affect the environment within which decisions about the energy supply system and its use are made more than they affect the decisions themselves. The classification of an energy supply system as a public or private utility is not concerned with the technological characteristics of the system, but with the manner in which the energy is made available to users. Similarly, energy usage is not controlled directly, but the setting of rates undoubtedly influences it.

Except for changes in land-use regulations and direct grants to support energy-conserving construction, most governmental strategies have an indirect influence on the design choices and energy use in privately developed communities. Taxation policies, financial regulations, utilities regulations, public investments, and information dissemination are mechanisms through which the decision-making environment can be altered to be more favorable for energy-conserving communities.

3 A CLOSER EXAMINATION OF SEVERAL INSTITUTIONAL SECTORS

3.1 INTRODUCTION

In Section 1, a primary objective of this study was given as an initial examination of the institutional environment for private, energy-conserving development. The preceding section outlined the structure of this environment. Considerably greater information about individual institutional sectors is needed, however, before the process, detailed in Appendix E and dealing with institutional factors, can be put into operation. The surveys reported in this section provide a basic understanding of several institutional sectors from which it is possible to make general predictions of their responses to some concepts that are likely to be included in community systems projects. In terms of the process diagram of Figure E.1, these studies carry out, to the degree possible with the present knowledge of community systems concepts, the steps of an institutional analysis process up to an evaluation of the importance of the identified factors.

Of the six institutional sectors listed in Table 2.1, three will be covered in this section: public institutional, private institutional, and consumer response sectors. The public institutional sector includes administrative agencies, legislative bodies, boards, and commissions that are accountable to the public at large. We are interested in these bodies to the extent that their normal responsibilities relate closely to the development process. Our emphasis on individual development projects is reflected in a predominant concern with local public decision-making, although state regulation of utilities has also been considered.

Groups composed of or accountable to a limited portion of the population based on occupation or business activity make up the private institutional sector. Labor unions, professional societies, trade associations, standards-setting bodies, and accrediting bodies are within this sector. Several of these having close affiliation with the development process are examined here. The survey of the third sector, consumer response, has been limited to residential purchase responses. Other elements of this sector (e.g. response to commercial purchase and lease options and behavior in using residential and commercial structures) are not so widely covered in the research literature, but should be examined in the course of the commercialization program.

A few generalizations about financial factors are contained in Section 2.2.1. The importance of the financial sector was apparent, however, even before the current project was undertaken. It was decided, therefore, to establish a companion project to this one which devotes attention to understanding financial roles in the development process. Study of the financial sector has also been carried farther in the factors process (Figure E.1), to the point of suggesting strategies for overcoming important factors. The results of that project are contained in a separate report, "*Financial Overview of Community Energy Systems.*"

The two other sectors--supply and management/operations--are not included in either of the current projects, having been judged to be somewhat less critical at this stage of the commercialization program than the other sectors. They will require investigation as the program proceeds, however.

3.2 PUBLIC INSTITUTIONAL FACTORS*

This section focuses on the institutional factors which appear most likely to hinder the public acceptance of community energy systems and energy-efficient design concepts. Will planners and other public administrators support these concepts, or will they resist them? How are elected officials likely to respond? Do existing laws governing land development and utility operations accommodate such innovations, or will changes in these laws be necessary? Concrete answers to these questions are premature at this point, since community energy systems are still in the early conceptual stages of design. Some preliminary indications of impediments to commercialization can be identified, however, by taking a closer look at the working of these public institutions.

3.2.1 Public Planning

Most planning functions in local government are organized around a planning commission--a body of appointed laymen (although sometimes elected) who review and approve long range planning policies for community growth and development, and also review specific development proposals. Depending on the size of governmental jurisdiction involved, most planning commissions are

*This section summarizes the topics covered in Chapter 5 of App. B, which was prepared by D. Mosena, D. Erley, E. Gil, and P. Slovak of the American Society of Planning Officials.

served by professional staff who provide technical support--conduct studies, monitor programs, review development proposals, and draft plans, policies, and legislation. Planning commissions are generally advisory, referring their recommendations on policy changes to legislative bodies for final action. Citizen participation occurs at a number of points in the planning process, both formally and informally.

Since the planning process is inherently political, with final authority for decisions resting in the hands of elected officials, its ultimate products tend to reflect the interests of its constituents to a large extent, or more accurately, those constituents and private interests who make themselves clearly heard. Professional planners are often less than pleased with the end results of the planning process, especially when professional principles are compromised for political purposes. Planners tend to be more receptive to innovation than many commissioners and elected officials. Thus, selling planners on new energy technologies and design concepts is important, but convincing planning commissioners and elected officials is equally if not more important since they ultimately control the decision-making process.

Due to the political nature of the planning and public decision-making process, a conservative, "don't rock the boat" attitude is likely to greet radically new energy technologies proposed for implementation at the community level. This does not mean outright rejection of new ideas, but it does mean that the superior merits of new technologies must be convincingly demonstrated in a variety of community settings.

Assuming consumer demand for new energy technologies and design options is forthcoming, and major technical performance problems are resolved (such as eliminating noise, odor, fumes, safety hazards, etc.), local planning institutions can be expected to respond positively to these concepts themselves. Their response to the 1974 energy crisis attests to the way in which planning institutions mirror public sentiment and consumer demands. During the energy crisis, planning activities in energy conservation seemed to rise and fall with the crisis itself.

Working in favor of energy innovations is the fact that many energy-efficient design options and related implementation tools have been promoted by planners for years in efforts to achieve objectives besides energy

conservation (objectives such as more environmentally sensitive site design and less monotony in development patterns).

Sympathy or even endorsement of these concepts does not necessarily mean that actual implementation will run smoothly. Several major, practical problems may present serious hindrances to the implementation of integrated community energy systems (ICES) and energy-efficient design concepts.

3.2.1.1 Land Use Policy Changes

It appears that ICES and energy-efficient design concepts can be implemented without the creation of new regulatory devices. Changes in existing zoning and subdivision regulations can be made to accommodate these innovations. Some of the zoning amendments necessary, however, would amount to significant changes in public policies embodied in zoning law, and may be debated at length in many communities. Locating energy production facilities in residential developments close to energy consumers involves a major policy change in conventional use restrictions. Moreover, relaxing the currently high degree of land use segregation found in most zoning ordinances to permit more mixed-use developments and more integration of land uses in general, will also require major policy decisions.* Such policy changes are frustrated further by the fact that the political time horizons of elected officials often do not coincide with the benefits of change itself. Initial risks must be taken by one administration, with long-term payoffs not likely to become visible until some later administration is in office. The success of such basic land-use policy revisions accommodating ICES will depend, to a large extent, on the strength of consumer demands for these technologies and the demonstrated performance characteristics of the systems themselves.

3.2.1.2 Information for Decision-Making

Lack of facts on which to base public policies is also a potentially serious constraint. Energy consciousness is currently very low among public institutions despite the recent energy crisis and continually rising energy prices. Public decision-makers currently are constrained from making rational energy-planning decisions because of a lack of specific facts and figures

*The effects of existing land-use regulations and desirable changes are discussed more fully in section 3.2.3.

demonstrating the benefits of various design options so that choices among energy alternatives as well as tradeoffs with other community goals can be made.

Not only are data scarce on the relative energy-efficiencies of various design options, but comprehensive energy consumption and consumer behavior data are almost nonexistent for specific communities. Energy-efficient, land-use planning on anything above the scale of a single development can quickly become overly complex because of (1) the high number of variables that must be considered, and (2) the lack of baseline data from which to begin. (Current ERDA research programs are beginning to address this need.)

As was the case with the environmental movement, considerable time lag can be expected for an energy ethic to become institutionalized. Commercial success of new energy technologies which must be marketed to a highly fragmented number of local communities and public officials will depend, in part, on a massive public education and information program. Even more important, general energy consciousness and improved baseline data will be necessary for planners and public officials to develop sound energy-planning policies.

3.2.1.3 Fragmentation of Public Institutions

Another potential hindrance to the commercialization of ICES is the highly fragmented nature of public institutions at the community level. Local planning and development regulation is still primarily controlled at the lowest level of government, in spite of increasing state and regional efforts to have a more active voice in land-use decisions. Each local planning jurisdiction is slightly different in character and governed by a slightly different body of planning law and regulatory techniques. Efforts to standardize the homebuilding industry on a national basis were hampered for years by the fragmented nature of the public institutional and regulatory process at the local level. This fragmented nature of public institutions means that ICES developers most likely will tailor project designs, and possibly the ICES hardware itself, to specific communities.

3.2.2 Administration

The administrative processing of development proposals is one of the potentially most serious barriers to the commercialization of ICES and energy-

efficient design concepts. Regardless of legality or public support, the constraints imposed upon developers during public review and approval procedures are becoming an increasingly critical variable in the developer's success. Both ICES and related energy-efficient design concepts lend themselves best to implementation through flexible regulatory techniques (such as planned unit developments (PUD), cluster provisions, performance zoning, and mixed use districts). Unfortunately, it is these types of highly discretionary and flexible land use controls which result in the highest administrative costs.

3.2.2.1 Administrative Implications of Flexible Regulations

As a general rule, flexible zoning techniques require some form of administrative review and approval procedure. PUD typically requires a rezoning application coupled with a two or three stage site plan review procedure. A three stage rezoning application procedure might have built-in time estimates totalling approximately 12 to 19 weeks. These review times are relatively low. Review case loads and the complexity and controversial nature of some development proposals have resulted in lead times of up to a year and more. Flexible regulatory techniques are generally perceived to result in higher administrative review times when compared to conventional development procedures, as shown in Table 3.1.

Table 3.1. Estimated Comparisons in Processing Time between PUD and Conventional Development

	Planners Percent of Responses	Developers Percent of Responses
PUDs are processed significantly faster	2.2	6.8
About the same	64.7	24.4
PUDs are processed significantly slower	33.1	68.8
Total Responses	100.0	100.0

Source: Planned Unit Development Ordinances, by Frank S. So, David R. Mosena, Frank S. Bangs, Jr., Chicago, Illinois: American Society of Planning Officials. May 1973.

Time is money, and increased review times translate directly into higher front-end carrying costs for such development expenses as interest on land options. This is especially crucial for developers operating close to the margin. The Urban Land Institute states:

Inadvertent or deliberate decisions delays on permit requests, negotiated standards for projects, and other familiar characteristics of contemporary development review processes have imposed significant front-end costs on development. In turn these costs have either been passed along to the consumer or caused cancellation of development plans.

Other complications raised by flexible regulatory procedures include costs of preparing applications and impact statements, the necessity for more sophisticated staff to manage projects (both in public agencies and in private development firms), and more negotiation and discretion exercised by public officials, which in turn can result in more costly demands on developers for design changes, extra amenities, and so on.

All of these constraints imply higher levels of uncertainty and higher costs for developers. In the present financially tight market, many developers have gone back to the basics of conventional subdivisions and the single-family home, avoiding fancy, flexible devices which they can no longer afford to get bogged down in.

3.2.2.2 Interdepartmental Coordination

Development proposals typically involve other public line agencies with single-purpose responsibilities for such services as police and fire protection, streets and roads, water and sewer, etc. In a typical rezoning application procedure, all applications automatically go to the engineering and traffic departments for review and comment. As more single-purpose agencies become involved in administrative review procedures, the process tends to become more complex, costly, and time-consuming. Also, public service line agencies have legitimate concerns about innovations in development. Narrower and more complex street systems in residential developments could inhibit the delivery of police and fire protection services, through restricting emergency vehicle access. Problems are compounded when veto authority over development applications is vested in several agencies.

The integration of several energy supply technologies, coupled with energy-efficient design concepts could test the coordinating and administrative capabilities of local governments to their limits. Facilitating smooth, streamlined interdepartmental review procedures may be essential to the success of community systems projects.

3.2.3 Local Land Use Regulations

Land use regulations include zoning, use districting, lot area provisions, and yard and setback requirements. A description of each is given below.

3.2.3.1 Zoning

Zoning is a land use control tool which divides a community into use districts, and spells out standards and limitations for each. Permitted uses, lot sizes, yard and setback requirements, and height and bulk restrictions are established for different types of districts. The zoning ordinance is usually directly related to a comprehensive community plan that spells out growth and development goals and identifies where in the community certain uses should occur. Commercial, industrial, and residential districts are generally separated from each other; some specific zoning districts may include a mixture of two or three of these uses.

In many ways the intent of zoning (i.e., separating uses and maintaining relatively low residential development) is in conflict with efforts toward energy conservation. Restrictive districting and maintaining low density, single-family development--major purposes of zoning--promote energy intensive community development patterns. There are a number of provisions found in zoning ordinances that could inhibit the use of ICES and energy-efficient design options for energy conservation. They include use restrictions that encourage separation of uses, minimum lot area provisions that determine density, and yard or setback requirements that necessitate detached type housing.

Use Districting. For each district designated by a zoning ordinance is listed a number of permitted uses, permitted by right or subject to some form of administrative approval. In this way the ordinance creates zoning of primary residential, commercial, industrial, or mixed use. Residential districts tend to

be the most restrictive; many exclude virtually all commercial or industrial use. Even in progressive ordinances, innovative housing design concepts such as clustering and PUD are usually permitted only as special uses in residential districts, subject to an administrative review procedure. Many ordinances do not make such provisions, and those options are not possible at all. The result of this type of restrictive zoning is residential neighborhoods of single-family detached housing that have no commercial facilities for use by residents.

The underlying point of use districting, and of all zoning for that matter, is to protect various land uses from the negative impacts of other uses. It is necessary to separate residential areas from noisy, dirty, heavy industry or school and playgrounds from the heavy traffic of expressways. This reasonable concept, however, has been carried too far, in some cases. The availability of the automobile has made possible large expanses of residential neighborhoods, that are located miles from shopping centers or even small stores. Use districting could be relaxed when gross problems with mixing uses are not present. This would permit a lighter integration of compatible though different land uses, such as residential with neighborhood commercial facilities. The planning experience with planned unit development in the past, however, has indicated that the administrative review necessary in most cases to build a PUD discourages developers from doing so. If permitted by right, there would be a greater incentive to build those types of efficient housing.

In addition, ICES may require technologies that under present district definitions might be classified as commercial or industrial uses. These technologies would then be excluded from the residential neighborhoods where they were needed. The light industrial uses that may be part of new energy systems could be regulated in restricted zoning districts, subject to site plan review. If the performance of a community energy system is tolerable, with acceptable levels of noise, pollution, glare or visual disturbance, they could be included in primarily residential districts through the use of performance controls. It has become common practice to regulate industrial use through performance controls that set maximum levels for the variables mentioned above. Specific uses are not listed, but rather any use may be permitted as long as it meets the standards set forth for a particular district.

The concept could also be used to permit commercial facilities. Performance controls for this type of use might include maximum traffic generation, maximum floor area of a store, or hours of operation.

Lot Area Provisions. Provisions in the zoning ordinance for minimum lot size determine the density of a particular district. Large minimum lot size means low density. In residential districts density is traditionally low, with single-family detached units the most common form of housing. In the unincorporated areas of Cook County, Illinois, 96% of the land designated for residential use is zoned at a net density of 4.4 units per acre or lower. Where clustering of dwelling units is permitted as a special use, the cluster project usually must meet the density requirements of the district. If a PUD is permitted as a special use, it might not be strictly subject to the density and lot requirements of the district in which it is built. However, to be granted an increase in density, a PUD would be required to provide tangible benefits--exceptional amenities, design excellence, etc. --to the neighborhood in which it is located. A significant density increase may require a rezoning. The PUD in itself requires a special permit, but if its density substantially exceeds that of the district, it would require administrative approval including review by the local government council.

Although it is not yet clear what levels of density will be required for efficient performance of ICES, low density development tends to be energy intensive; new community design and utility systems for energy-efficiency may require higher densities. In addition, high density would require less extensive infrastructures for servicing by an ICES than a more spread out, low density development. In the event that these become priorities, minimum lot requirements must be revised or done away with altogether. Performance controls that set maximum lot coverage and thus preserve open space could take the place of lot area requirements. For example, a townhouse apartment project would not be subject to a minimum lot size, but rather would have to provide a percentage of the site area involved as open space.

Yard and Setback Requirements. Yard or setback requirements in zoning ordinances set minimum distances between buildings and between buildings and the street. In specifying minimum distances from front, side, and rear lot

lines, yard and setback requirements result in the centering of homes in the middle of their lots. These requirements also mean that building lines must follow lot lines; the shape of the lot determines the axis of the house.

For community energy systems yard and setback requirements could be a barrier to innovative building orientation and solar collector technology. Full-scale clustering requires flexibility in lot size requirements but the limited form of clustering of duplex housing could be prohibited by yard requirements. Side yard specifications would prohibit common wall construction. In order to orient buildings for maximum solar use, it may be necessary to position their southern facades a minimum distance from other buildings. Especially in developments with small lot sizes, this would require some type of zero lot line zoning, allowing buildings to abut lot lines. Rigid yard and setback requirements would make this impossible.

In order to facilitate ICES components, the yard and setback requirements discussed above must be flexible. They could take the form of a performance standard that specified a minimum total lot area without dictating the distribution of yard space on the lot. In this way building orientation, solar collectors, and duplex housing would be possible.

3.2.3.2 Subdivision Regulations

Subdivision regulations control the process by which land is divided into developable lots. They regulate layout of lots and streets, design standards, construction of public utilities (streets, sewers, etc.) and the provision of open space.

The provisions of subdivision regulations that could have the greatest influence upon the introduction of ICES are those that deal with the layout and design standards for streets. These provisions have a direct influence upon site and building orientation and upon future automobile use.

Street Layout Requirements. Subdivision regulations set forth recommendations for the design of circulation systems. In the past these provisions have specified street layout that was primarily based on the grid system. Many communities have recently amended subdivision regulations to

encourage curvilinear street design and use of cul-de-sac streets. Grid type street layout is encouraged in new developments through subdivision specifications that new streets be in alignment with existing streets. "As far as practicable, all proposed streets shall be continuous and in alignment with existing streets." In this way, both the pattern of street layout and the directional orientation of streets are dependent upon the established circulation system. In addition, the use of non-through streets like cul-de-sacs while not expressly prohibited is accorded somewhat less acceptance than conventional streets.

Grid street layout in a development requires considerably longer streets than curvilinear design using cul-de-sacs. Even at low density, innovative street design can shorten the linear footage of necessary roadway by a great deal. Excessively long and wide streets promote energy consumption in a number of ways: 1) extra energy is required for materials, construction, and maintenance; 2) extra impervious coverage may increase flooding that requires energy in flood control or damage repair; 3) extra coverage with concrete and asphalt tends to increase air temperature in the summer which places greater demand on air conditioning energy use; and 4) wide streets encourage auto use and discourage bicycling. In addition, grid layout provides very little flexibility for lot and building orientation to the sun. In combination with traditional lotting requirements, traditional street layout can prohibit most buildings from orientation to the south.

Street design specifications in subdivision regulations are not so rigid as other types of provisions. This area of subdivision regulations is not so much a disincentive to energy-efficiency, but rather an opportunity for incentive that could be taken in the future. Guidelines that recommend total system approach to street design with the incorporation of bicycle and pedestrian elements could be a significant incentive to provide efficient street layout. The issue of directional orientation for use of the sun could also be raised in subdivision regulations to further encourage innovation.

Street Width Standards. Subdivision regulations set very specific standards for the design and construction of project streets. Maximum grade, radii of curves, and street width specifications are among those set forth. Width standards vary depending upon the type of street and its traffic volume.

Many communities may be using street width standards that are excessive for adequate performance. Reducing street standards to an acceptable width for safety and adequate ease of circulation would save significant energy in the form of construction materials and by discouraging automobile use to some extent. Developers would welcome this reduction because it would save them a great deal of money; residents would in turn benefit by having to pay less for homes.

Subdivision regulations also contain provisions requiring the construction of sidewalks in new development. In a typical ordinance, any subdivision of more than 1.5 dwelling units per acre (very low density), must have sidewalks on both sides of the streets. Like large street width standards, requiring sidewalks on both sides in most of the development in a community may be unnecessary for acceptable levels of performance. Especially for cul-de-sac streets that have very little traffic, only one sidewalk may be adequate, and there may be times when none are needed, without discouraging walking or biking.

In reviewing subdivision standards for street width and sidewalks, the performance approach is once again a promising means of regulation. Many subdivision regulations simply give one width figure for each general type of street, ignoring the substantial variation in traffic volume within each category. Street width standards based on projected automobile use or neighborhood density would mean custom tailored and less wasteful street construction.

3.2.3.3 Aesthetic Controls

As of 1968, ASPO was aware of 72 communities with some form of architectural controls. In these towns and cities, an ordinance or review board regulates architectural design of new developments to some extent. Design standards in an ordinance or review guidelines for a board address building materials, architectural style, building color and other aspects of building design. The purpose of such regulations may be to prevent monotonous development or to preserve the character of a historic district or to promote a unified aesthetic style in a neighborhood or community.

Aesthetic controls can serve to limit flexibility in building and site design. Community energy systems may require innovative design to accommodate new technology or building design for solar utilization. For example,

buildings oriented toward the south for maximum heat in the winter will require overhangs to keep the house cool in the summer. In the event that architectural controls prohibit this type of design, they would require revision to facilitate this design option. In addition special apparatus or technology necessary to community energy systems such as solar collectors or central heating plants could, be prohibited by architectural controls. Ordinance provisions and review criteria could be expanded and made more flexible to allow for the new technologies and design irregularities necessary to energy efficient community systems.

3.2.4 State Utility Regulations

In examining the impact of the administration of state utility regulations, we have reviewed the legal analysis contained in the Technology Assessment of Modular Integrated Utility Systems. This has been augmented with a closer review of the relevant statutory and case law in Illinois and conversations with several members of the state utility commission in Wisconsin. In Illinois, and perhaps other states as well, there is almost no direct experience with energy systems of the kind envisioned in the Community Systems program. At this time, therefore, the discussion of impacts is largely speculative, based on implications of the regulatory provisions, supported to some extent by case law treating other, comparably sized utility systems.

3.2.4.1 Classification as a Public Utility

A major item of concern is whether the system would in fact be considered a public utility, subject to regulation by the state. This determination hinges on the key concepts of "public use" and "sale" of the utility service. Case law leaves room for significant uncertainty about the "public use" character of community energy systems. The uncertainty is emphasized by differing determinations in two states (Utah and Massachusetts) regarding shopping centers which engage in a "total energy plan" in which owners of the shopping center generate electricity and provide their tenants with heat, light and air conditioning.

Although the degree of public use is the primary factor in the classification of a public utility, a great deal of emphasis is placed on the fact of resale energy. The criterion could well be that if the energy is owned or

developed by one party and sold to others, then the first party is considered a public utility and will be regulated by the state utility commission. It would seem reasonable to expect the commission to assert jurisdiction over any system which measures the amount of energy used by the consumer and charges according to use (i.e., metering or sub-metering would probably mean automatic regulation). On the other hand, if a developer provides energy strictly as a service to his tenants, the system may not be subject to regulation (e.g., provision of water or electricity by the owner of a trailer park might not be subject to regulation).

3.2.4.2 ICES Ownership

The manner in which an ICES is developed and owned could have a bearing on the classification as a public utility or not. Two alternative means of ownership are suggested here, with a brief analysis of the legal consequences of each. It is assumed at the outset that there would be no benefit to establishing a partnership or corporation to own an ICES, since the system will presumably be developed and used on too small a scale to warrant the complexities of partnership or corporate ownership. The possibilities of the limited partnership and the close corporation should be kept open, however, and may warrant further investigation when the magnitude of the ICES is better established.

Developer Ownership. The first form of possible ownership of an ICES is developer ownership. At some point, the developer will necessarily own the ICES since (s)he will be responsible for its initial installation. The developer could retain ownership of the ICES and charge his tenants for their use of his utility system. Since it is not clear how the courts in many states would rule in such a situation (see above), it is not clear whether a developer/owner would be classified as a public utility and thus subject to regulation. It is possible, however, that the state utility commission and the courts would view such an arrangement as "rent inclusion," lacking sufficient resale aspects to warrant regulation. In such a situation, the developer and his tenants would presumably contract for the supply of power, and the developer/owner's responsibilities and liabilities would be governed by the terms of the contract instead of a Public Utilities Act. It is worth noting, however, that even if the courts ruled initially that the developer/

owner was not a public utility, the commission might view the ICES as a system which should be regulated in order to protect consumers.

Common Ownership. The second form of possible ownership of an ICES is a condominium-type ownership by the owners of the units supplied by the ICES. Under such an arrangement, condominium owners ordinarily own common areas as tenants in common and the unit owners are liable for their share of the common expenses. It might be possible to consider the ICES as a common area of which each unit owner owns a percentage and for which all unit owners are responsible and liable. Thus, a part of the unit owners' monthly assessment would be used for the supply and maintenance of the ICES. Again, it is not clear whether such an arrangement would be considered a public utility although it is arguable that the energy is neither being resold nor offered for public use. However, it would not be wise for developers of the ICES to depend upon a form of ownership to shield the ICES from regulation as a public utility, since regulation will occur anyway if the legislature perceives a need for it.

3.2.4.3 Consequences of Classification

If an ICES is determined to be a public utility, the provisions of the state regulations will have significant influences on its operation. Included will be control over rate schedules, prohibition against discrimination in provision of service, and liabilities for damages arising from violation of any provision of the regulations. The effects of the three provisions listed would not be different for ICES than for any other means of supplying utilities to a project, but they might represent unfamiliar and unwelcomed constraints to ICES owners.

One provision that might have more important consequences for the adoption of ICES concepts is the requirement for a public utility to obtain a certificate of public convenience and necessity before beginning construction of the facilities. If the ICES were proposed in an area within or adjacent to the service area of an already certified public utility, the existing utility might raise objections to granting the required certificate. A standard of ability and willingness of the existing utility to provide service to the new area is a primary consideration in most certification determinations. Unfortunately, the absence in some states of experience with electric supply

systems closely comparable to ICES makes it difficult to anticipate the decision in a controversy between ICES and an existing utility.

It is not clear whether an already certified utility would be able to insist on providing service to any development in an area which it already services (akin to a right of first refusal) even if the ICES is not considered a public utility. For example, the question of whether an ICES could be installed in a new office building in downtown Chicago over the objections of the public utilities which already service the area has not been answered. It would appear that some state utility commissions are endowed with a great deal of discretion and might be able to authorize such an experiment.

One other statutory provision that could represent a significant departure from the operation experience of some potential ICES owners prohibits a public utility from abandoning or discontinuing service without public utility commission approval. There is indication in case law that mere failure to make a profit is not a sufficient reason to support abandonment.

3.3 THE INFLUENCE OF PRIVATE, NON-FINANCIAL INSTITUTIONS ON THE ACCEPTANCE OF INTEGRATED COMMUNITY ENERGY SYSTEMS*

The commercial potential of Integrated Community Energy Systems depends upon the acceptance of the various designs and components of these systems within the building industry. Among the direct participants in the process of commercial acceptance, we have focused on four categories of actors: 1) building code authorities and model code associations; 2) construction industry associations; 3) construction trade unions and labor organizations; and 4) real estate appraisers and realtor associations.

3.3.1 Building Codes and Their Effect on ICES

3.3.1.1 The Existing Building Code System

Over 12,000 communities in the United States have some system of building permits as the basis for authorizing construction on privately held lands. These permits require the adherence to some set of minimum standards for the design, materials, construction and use of buildings. Estimates on the number

*Sections 3.3 and 3.4 were prepared by C. Lenth as summaries of Appendices C and D, respectively.

of different building codes in effect range from 5,000 to 10,000. There are over 4,000 separate code administering agencies in cities which have populations of over 5,000, with over 30,000 variations in their codes. Counteracting this decentralization of authority and lack of standardization, a relatively small number of nationally recognized associations, professional groups, regional affiliations and state agencies participate in the complex process of model code formulation and foster a recognizable organization in the building code system. Four private, service-oriented model code associations publish model codes used by the majority of local code agencies. Other organizations participate in the testing of products and the setting of standards.

In brief, in the existing building code system, private, quasi-public, state and federal government actors work within a complex process to formulate model codes which are adopted in varying degrees of uniformity by local governments and regulatory agencies. Many organizations with oftentimes conflicting objectives have an input into this process, including building industry groups, consumer spokesmen, special interests and elected officials. Drawing from so many different perspectives, the model code system is often slow to move and typically attempts to forge positions which offer some degree of satisfaction to all parties. Moreover, there is considerable slippage between the standards suggested by model codes and those adopted by local authorities. The uniformity achieved through the model codes must be seen against a background of complex local modifications, and the advantages of standardization must be balanced against the need to maintain local options.

3.3.1.2 Effects on the Commercial Potential for ICES

Assessments of the commercial potential for ICES need not be premised on a costly and unlikely restructuring of the entire building code system. There is a well-developed system of arbitration and established mechanisms for change within the existing organizations and practices. If ICES involves designs or components which cannot survive these processes in order to effect necessary code changes, it is unlikely that they would be acceptable to the existing building industry. Given what is now available on the technical components of ICES alternatives, it seems unlikely that any radical code changes, changes which cannot be handled within the existing system, will

be necessary. However, there are several areas in which modifications of building codes and improvements in the system of code formulation and administration should be encouraged. Without appropriate changes, it seems likely that these factors would impede the adoption of ICES designs and components.

Within the building industry, and particularly among construction firms, the system of local building codes is viewed as a troublesome labyrinth of regulations which inhibits innovation. In extreme cases, builders decline work or claim that codes add unnecessarily to construction delays and final costs. Complex reasons underlie the perception that building codes inhibit innovation.

Specification vs. Performance Codes. Local code authorities typically issue specification-type codes which require the use of code approved materials, designs or practices in building construction. This means that builders are discouraged from exploring the use of alternative materials and designs because of time consuming and costly delays involved in getting code approval for unspecified items. Code agencies are often slow to approve alternatives because of the lack of resources for testing products at the local level. Specification codes are a particular hindrance to the adoption of energy conserving materials and designs, since these involve a new category of code standards and often include substantial changes in past practices.

The alternative to specification codes is the use of codes which set standards for the overall performance of materials and designs. These would leave builders free to use new methods and materials, as long as they meet performance standards set by the codes. For example, the code standards in regard to the energy usage characteristics of buildings could be achieved by different builders using different materials and designs. Builders would not be required to go through the process of initiating code changes (the specification of new items), but merely to demonstrate that the proposed changes meet or surpass the authorized performance levels. While existing specification codes would slow down and otherwise hinder the adoption of ICES designs and components, performance codes would pose no such hindrances. Moreover, more stringent standards for energy usage in buildings under a system of performance codes would encourage the adoption of appropriate ICES technologies.

Performance-type codes have been advocated by the model code associations and by state governments for a number of years. But they have not been widely adopted by the local level code agencies, primarily because specification codes are cheaper to administer and require lower levels of expertise. More money should be provided by local communities, or, more likely, by state legislatures or through federal revenue-sharing for the administration of performance codes. High professional wage scales would attract engineers with the requisite education. Training programs could be maintained by state universities, regulatory agencies or construction industries in order to enable building code officials to administer more complex standards. The network of private and governmental product testing laboratories should be expanded in order to provide services to local code authorities. Testing methodologies and evaluation procedures could be standardized through state and industry support. Such programs would increase the likelihood that local authorities will adopt performance-type codes, which, in turn, would ease the acceptance of ICES and similar developments.

Slowness to Adopt Changes. A second potential hindrance to the acceptance of ICES within the existing building code systems stems from the system's general slowness to act and undertake necessary changes. This results in part from the same shortage of adequate funding, training and facilities, and from the maintenance of specification codes. Again, with state aid these weaknesses could be corrected. A more general problem is that the code associations and authorities attempt to achieve consensus within the building industry, rather than enforce policy positions. With more extensive state and federal support, code authorities might have more independence from special interests and be able to follow policy decisions made in the elected branches of government.

Local Variations in Codes and Enforcement. The propensity of local authorities to modify model codes and to be ineffective in enforcing building regulations also bears on the commercial potential of ICES. Only seventy percent of local authorities base their building codes directly on the available model codes, and the majority of these do so only with locally determined modifications. These figures could be improved if model code programs were given more resources and support; the desirability of local options to fit

particular community needs and the advantages of decentralized code administration could be maintained even if model codes were more effectively promulgated and more uniformly used. Model codes should be developed and applied on different levels for appropriate regional divisions. Some building code standards are appropriate for nationwide application; energy usage standards are perhaps one example, fire safety regulations, another. Other standards, for example those concerning building materials and designs, might be more appropriately developed on a regional or state level. Finally, programs could be initiated to develop model building codes in more detail for distinct geographical areas or metropolitan regions at the sub-state level. The adoption of model codes according to an appropriate pattern of levels would lessen the complexity of local variations and ease the problems of code approval faced by builders. Such a program could be stimulated through expanded state and federal support for model code associations, and would increase the potential for the commercialization of energy-conserving material and design options such as those which are included in ICES.

Energy Usage Standards. Finally, the commercial potential for energy conserving design and material options is lessened by the lack of energy usage standards within existing building codes. This is likely to be changed in the near future. The ASHRAE 90-75 Standards, "Energy Conservation in New Building Design," have been in the process of development and evaluation for several years. The model code associations have conducted extensive hearings on these standards and are presently involved in submitting appropriate code changes and additions to their memberships for approval. It appears that these standards will be included in some model codes by 1977. ASHRAE has developed a similar set of standards for existing buildings, but the acceptance of these standards will take additional time.

In short, there are several impediments within the existing building code system to the commercial acceptance of ICES designs and components. The perception that building codes inhibit innovation in the building industry, the continued reliance on specification rather than performance-type codes, the slowness of the system to change and its need to rely on voluntary adherence, the laxness in code enforcement, and lack of effective energy usage standards within building codes all decrease the commercial potential for

energy conserving alternatives. None of these factors, however, needs to be viewed as a barrier to the ICES program. From the perspective of ICES, there is no need for the radical restructuring of the building code system. The changes which are suggested are more modest; they work within the existing system to promote changes which will increase the potential for the acceptance of energy conserving technologies and components.

3.3.2 Construction Firms and Trade Associations

The next three sections consider three important categories of actors within the construction industry, beginning with construction firms and trade associations. The American construction industry is highly fragmented, decentralized and relatively fluid. It involves so many different producers and categories of suppliers that no exact total is known. The Associated General Contractors of America, an organization of large contractors engaged in commercial and heavy construction, has 9500 members. The National Association of Home Builders has 75,000 members, consisting of residential construction firms and companies which service the housing industry. In addition to these, there are thousands of private builders and unaffiliated construction and contracting firms. Private builders and even large firms move in and out of the market; during a construction boom the industry expands, contracting again as firms drop out of the industry when there is less work available.

The organization which does exist in the construction industry is a form of horizontal stratification. Categories of firms operate, interact and generally compete within particular levels. The Associated General Contractors (AGC) is the primary organization of the large firms. On a lower level, there are organizations of specialty contractors, subcontractors and smaller firms who engage in commercial and heavy construction but are generally not the primary contractors for large projects. Finally, the National Association of Home Builders is the primary trade organization of the residential construction industry. Within these categories of construction and respective levels and types of construction, there is competition between firms, though the degree of competition varies from region to region. The relative ease of entry into many types of construction increases the likelihood of competition. Between these levels, however, the competition is restrained. Firms engaged

in heavy construction do not normally compete in the decentralized, residential market, while small builders do not have the resources to bid on large projects or specialty contracts.

The construction industry as a whole would have little reason to object to ICES, since the construction would be undertaken by private firms. However, insofar as the principal associations are representative of the traditional interests and practices of the industry, they would have no particular interest in supporting ICES. It can be anticipated that building industry associations will support ICES only if it appears that such a program will benefit their memberships. On the other hand, if ICES appears to foster competition between the horizontal strata of the industry, then it should be anticipated that the program would be opposed by the group which would be adversely affected. For example, if the NAHB determined that ICES represented a significant step away from single-family patterns of residential construction and thus would reduce small builders' share of the housing market, the trade association would be likely to oppose the program by the means at its disposal. A shift to larger building projects, and to projects which included integrated utility systems which might require heavy construction techniques, clearly would be against the interests of small residential builders. The other side of the coin is, of course, that the AGC might support ICES if it saw in the program an opportunity for large contractors to increase their share of the housing market. Whether or not opposition or support for ICES from one of the categories of construction firms materializes must await further clarification of the technical plans and the degree of governmental support. There is, however, the distinct possibility of opposition from any adversely affected quarters of the industry.

3.3.3 Trade Unions and Labor Organizations

In many ways, the labor unions in the construction industry are better organized than the construction firms. Within the central associations, there are well developed means for handling most conflicts, and the challenges from alternative organizations are not severe. The building trade unions are federated into the 3,500,000 member Building and Construction Trades Department of the AFL-CIO. The federation consists of the various craft unions; the 800,000 member brotherhood of carpenters is the largest, followed by the laborers, iron workers, painters, plumbers, electrical workers, plasterers

and others. These craft unions operate through local union halls. The Building and Construction Trades Department is also divided, with 530 state and local councils. These building trades' councils coordinate the activities of local craft unions and maintain a united front for the purposes of labor negotiations. However, the dominance of the craft unions affiliated with the AFL-CIO in the construction industry is far from complete. There is still much non-unionized labor employed in construction, particularly in rural areas and in the South. Though the control by the craft unions is nearly complete in most urban areas, even in the heavy construction related to energy resources and utility systems only about 70% was done by union workers in 1974. Another challenge to the AFL-CIO craft union dominance comes from the independent, non-craft unions which have been expanding in recent years. These are construction unions organized on the basis of plant unions; they include all workers who work on specific construction projects, without dividing them into craft unions.

Despite these alternatives to AFL-CIO craft unions, it would be advantageous for ICES to seek support from this primary labor organization. Opposition from the AFL-CIO affiliates would block the ICES projects in most areas, and this opposition would materialize if the projects became identified with alternative organizations or non-union labor. On the other hand, support from the craft unions would work in favor of ICES proposals, since the projects might then receive support through the AFL-CIO educational and legislative programs.

Support for utilization of ICES designs and components should not be anticipated as immediately forthcoming from the craft unions. Indeed, several factors and aspects of the traditional practices of craft unions would pose obstacles to the acceptance of ICES projects.

Traditional reluctance of organized labor to accept new materials and methods is clearly evidenced in the construction industry. The high degree of unionization along with the proliferation of craft unions contributes to this resistance. Innovations are discouraged by demands for payment to compensate for labor saved through changes in construction practices or materials. Moreover, the craft-based construction unions rely on apprenticeship programs and field training, rather than on educational qualifications and technical

training. These practices tend to enhance the traditional orientation of the membership, and emphasize the closed nature of the unions. The adoption of ICES designs and components would involve the introduction of new products and practices with no clearly assigned responsibility for the classroom or on-site training of construction and maintenance workers that might be required.

Introduction of energy conserving technologies, systems, components, and materials might give rise to jurisdictional disputes among competing craft unions. Solar collectors or other HVAC components that are more thoroughly integrated into building designs might lead to disputes among craft unions. For example, that factory-produced components would be resisted by unions that work in on-site construction.

Finally, decentralization and integration of utility and energy systems would disturb the current patterns in the construction industry. Heavy commercial construction related to utility systems has increased in importance relative to other sectors. A shift in construction patterns away from large-scale utility construction would cause at least short-term dislocations, and for this reason might be opposed by particular labor unions.

These factors point to the possibility that ICES designs and components may be initially resisted by some labor organizations within the construction industry. But this potential resistance need not be seen as a barrier to the commercial acceptance of ICES projects. It would be helpful if the ICES program would seek and receive support from the AFL-CIO craft unions in the construction industry. Failing to do this, however, there is still little reason to anticipate that labor problems would be insurmountable. The factors outlined here are in the nature of traditional resistance to change and short-term dislocations. Adequate training, support, and public relations activities would help to ease these transitions and to achieve eventual labor support for ICES projects.

3.2.4 The Role of Real Estate Appraisers and Realtors

Once the construction process is completed, another category of actors and organizations influences the commercial potential of the products of the building industry before they finally reach the consumers. Realtors who market the products and real estate appraisers who calculate the market value of

property mediate between the producers and the consumers. In these roles, they are aware of consumer preferences and market values, and they may influence the commercial potential of housing and other construction products.

At present the role of realtors and appraisers in influencing building standards and market values relating to energy usage and utility system designs is very diffuse and indirect. Realtors and appraisers tend to deny any involvement with the energy-related characteristics of buildings. There are no standards, guidelines or even suggestions published by realtor and appraiser associations which bring energy-related concerns to the attention of their memberships. The influences of these concerns in the processes of appraising, underwriting and marketing are minimal.

There are several reasons for this lack of concern by these professions for energy usage standards. Realtors and appraisers commonly have backgrounds in business and economics; they have for the most part only general knowledge of building standards and practices. They do not have the requisite training to deal with, let alone establish or promulgate, energy-related standards in building appraisal or investment planning. Second, typically they rely exclusively on unit-in-place cost techniques. Energy design and usage characteristics enter these calculations indirectly, and they are not yet considered significant factors. The tendency under such practices is to discourage higher initial energy-system investments and to discount energy costs as part of building investment. Third, they view their own role as that of a thermometer in the market place. Appraisers and realtors deny any direct role in commercial acceptance of different types of construction. They see their roles as no more than determining what a building is worth in the current market, and this they see as established by the buyers.

These characteristics and the denial of a direct role in influencing energy-related standards should not be taken as an indication that realtors and appraisers have no related influence at all. While their job is not to educate the public, their role in relation to consumer and governmentally determined appraisal standards is complex. Building appraisals and the determination of a borrower's capacity to make an investment and keep up with mortgage costs clearly should include some consideration of the energy consumption of buildings. The addition of an energy usage assessment to lending, appraisal and marketing practices would help to make the public aware of these considerations.

In several respects, the current practices and operating rationales of realtors and real estate appraisers are a potential hindrance to the commercial acceptance of energy-conserving building designs and utility systems. The higher initial costs of these designs are not measured against the potential savings in usage, life-cycle and utility costs. The establishment of appropriate energy standards, life-cycle and building maintenance assessment techniques for realtors and appraisers would bring these considerations to public attention and probably increase the attractiveness of ICES designs. There are many technical problems involved with energy standards which remain to be solved. But it does seem that energy usage standards could be established to be administered as part of the processes of appraisal and the determination of investment potential and mortgage qualifications. It is unlikely that appraisal groups or lending institutions will undertake such changes through their own initiative. Changes will come only as a result of pressures from other sources or from substantial changes in existing market conditions.

3.4 FACTORS THAT INFLUENCE THE RESPONSE OF HOUSING CONSUMERS TO INTEGRATED COMMUNITY ENERGY SYSTEMS

Among the types of consumers of ICES in private developments, the most frequently studied are consumers of housing. Many kinds of residential communities exist, ranging from clusters of high rise structures to detached houses in suburban tracts, with densities along a continuum from very high to almost rural densities on the urban fringe, and having been developed with varying levels of unified planning. This richness of detail and its relation to the social attributes of the populace make it an attractive area of investigation. Because of the relatively extensive literature on consumer responses to housing alternatives, it was chosen for the initial review of consumer responses. Other consumer segments, such as lessees of commercial units, must be similarly reviewed in the future.

The literature review done for this report examined evidence on consumer evaluations and public attitudes in regard to housing alternatives, community designs and residential energy usage. The potential consumer response to ICES designs and components was then analyzed by drawing parallels between these available materials and certain presumed characteristics of

alternatives. Examining the projected consumer responses, in turn, is a means of estimating the commercial potential for ICES.

The resulting prognosis is neither optimistic nor pessimistic. Rather, it attempts to realistically point out the areas in which consumer resistance is likely to be encountered, while at the same time demonstrating the commercial potential of ICES if these challenges are successfully overcome. The preponderance of evidence underscores the fact that the ICES program cannot assume that the philosophy of a planned community is an eminently popular attraction in today's housing market, that current community designs and utility systems can be rearranged without encountering public resistance, or that an expanding ethic of energy conservation will lead American society to unhesitatingly embrace ICES alternatives.

This research has uncovered a number of potential hindrances to the acceptance of ICES designs and components among consumers in the housing market. These factors can be summarized as follows:

a. The concept of a highly planned community has a limited appeal and biased diffusion within American society. Planned communities appear to be most attractive to Americans with relatively high levels of education, who tend to have white collar employment, and who have much higher-than-average incomes. Planned communities appeal to housing consumers who desire well-developed community amenities. Conversely, less-planned communities appear to attract residents who place higher value on privacy, independence, and closeness to nature. It must be assumed that the existing patterns of housing and community development in this country largely reflect underlying residential preferences. In short, different degrees of community planning are related to the underlying preferences of community residents and to different values in American society.

b. In general, high residential densities are viewed as an undesirable characteristic of communities. In part, this is due to the common association between high densities and unattractive community features. To overcome this association, high-density housing developments must incorporate an unusual set of amenities. Only the more highly planned communities appear to be relatively receptive to higher-density levels.

c. On the basis of the degree of satisfaction expressed by residents, there is no clearcut distinction between planned and less-planned communities. All types of communities receive mixed ratings of approval and disapproval; among planned communities there is often as much variation in the degree of resident satisfaction as between these and the less-planned communities. The evidence gathered for this study shows that there is no clear, generalizable definition of community planning in this country, and no common conception of what the features or attractions of a planned residential environment are or should be.

d. Consumer decisions in the housing market do not give high priority to the energy-related components and consumption characteristics of buildings. If higher initial investments are required for more energy-efficient designs and utility systems, these will not be attractive to consumers and lending agencies who do not calculate usage and life-cycle costs. The evidence indicates that conservation behavior is undertaken primarily in response to price increases in energy sources; thus, it cannot be assumed that there is a mushrooming ethic of energy conservation which will make ICES alternatives immediately attractive. Although there is a good deal of public awareness of energy resources and national resource constraints, it is not clear that this increasing public awareness has produced significant long-term changes in behavioral patterns.

e. Unconventional utility systems and components integrated into community environments and involving high levels of community interdependence and organizational interaction will require adjustments in current lifestyles and public attitudes. The dominant public attitude toward the provision of utility services is that they should not in any way impinge on community life, appearance, or convenience. The integration of utility components into communities might involve both adjustments in the physical arrangement of neighborhoods and a new set of community-oriented attitudes toward the provision of necessary services.

f. ICES projects could be opposed by a variety of indirectly affected community groups. For example, environmentalists might severely question the safety features and the potential pollution by ICES. Neighboring residential groups who would not share in the benefits of ICES projects might oppose

construction within the community environment. The federal funds or guarantees necessary to finance ICES projects might require the implementation of various social goals such as mixed-income housing, which could hinder community acceptance. Opposition in these areas of potential conflict could diminish the commercial potential of ICES projects. Prolonged and bitter debates in the process of local community review of construction plans could adversely affect the consumer response.

Relatively high levels of opposition to the location of conventional electrical generating plants within community areas demonstrate the continuing concern over the threats to health, property and neighborhood appearance posed by these facilities. This same opposition would be faced by modular, integrated components of ICES projects if they presented the same hazards and pollution characteristics as conventional systems. ICES projects should anticipate community opposition to the integration of utility components and work to dispel the fear of pollution and health hazards.

The apparently favorable public attitudes toward the development and installation of solar components are an encouragement to the ICES program. Although the program may not be based primarily on solar technologies, the ICES projects are likely to integrate some solar energy components. Moreover, the public attitudes toward solar energy may be indicative of a willingness to adopt other new technologies that can be demonstrated to be clean, reliable, and relatively resource efficient.

The conclusion reached in this examination of the relevant materials on consumer decisions and public attitudes is that the consumer response to ICES projects will be neither unhesitating acceptance nor blanket rejection. There is no basis in the evidence for the assumption that American society will enthusiastically embrace highly planned community developments and energy conserving changes in current lifestyles. However, there is no need to assume that Americans are unwilling to change, that they would reject these alternatives, and that they are unconcerned with the growing need to conserve energy resources.

It is unrealistic to base the expectations for the ICES program on the public's willingness to undertake completely voluntary changes in lifestyles. Encouraging certain incremental changes in housing patterns and public

attitudes must be seen as part of the task of the program. The ICES program cannot be viewed as one of purely technological innovation. It must be seen primarily in terms of a program for social change in connection with the slow diffusion of new technologies. In other words, the commercial success of the program will be influenced by its ability to encourage appropriate changes in American society.

This analysis shifts the responsibility for the potential commercial acceptance of more highly planned community developments from the consumers to the builders, the financiers, and the relevant public policies. To assume the popular appeal of a philosophy of community planning in the face of the available evidence is to assign the costs of change and acceptance to the public at large. This is unrealistic and decreases the potential success of these programs. The ICES program must assume that planned community development is not particularly popular within the current housing market. Under the circumstances, it must attempt to adapt its proposals for more energy-efficient designs and components to existing housing preferences. The program should work to accommodate different community types to expand its commercial potential. It is encouraging that there is evidence which shows that higher living densities tend to be more acceptable in more highly planned communities. The ICES proposals should take advantage of this factor to encourage certain types of community development. It seems unavoidable that to increase energy conservation within residential housing will involve some changes in current lifestyles. To encourage these changes and to achieve the greatest possible degree of program flexibility to accommodate varying lifestyles must be recognized as part of the task of the ICES program.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 GENERAL RECOMMENDATIONS FOR THE STUDY OF INSTITUTIONAL FACTORS

Throughout this project there has been an often-repeated comment by project personnel and advisors alike that evaluations of the actual importance of many potential institutional factors will depend on greater descriptive detail for community systems designs than has so far been available. If the concept of systems design is intended in its fullest sense, it is not possible to state *a priori* the full characteristics of any one element of the design. The assumed design elements that have been used at points in this report to draw out inferences of institutional responses might be central to some designs and insignificant in others. Nor can the institutional responses themselves be accurately assessed outside of a real institutional context. Whether zoning regulations or required rates of return on capital are more important requires knowledge of a specific development proposal. Without that kind of detail, only general indications of potential institutional factors are possible.

Because the study of institutional factors is so dependent on design details, it is recommended that future work in this area be integrated with design efforts through case studies. This is certainly in keeping with the intentions of the Community Systems program to have all elements interact closely. The analyses of the institutional portion of the case studies could follow the process that has been outlined in Appendix E. Further studies of the kind that are reported on here might be profitably undertaken, also, but primarily in response to identified needs for greater background knowledge of specific institutional actors.

4.2 CONCLUSIONS AND RECOMMENDATIONS FOR PUBLIC INSTITUTIONS

Acceptance of the community energy system concept should be relatively widespread among public institutions, assuming that these systems achieve their design goals (and barring any unforeseen negative impacts which might surface as designs for these new technologies become more specific).

Specifically, the planning community should have no trouble endorsing such innovative concepts. Energy efficiency is now a public policy objective

in several community master plans. Planners have been promoting many energy-efficient design concepts for years, usually for other reasons than energy conservation. Trends toward greater public acceptance of flexible development regulations like PUD and performance zoning should also facilitate implementation of ICES. Furthermore, existing growth management policies and environmental quality objectives, common in an increasing number of communities around the country, directly complement many of the elements of ICES and related design concepts.

In spite of these positive factors enhancing the success of ICES, the actual implementation of these technologies is likely to encounter a number of practical impediments. It is premature at this stage in commercialization research to predict whether any one or combination of these impediments would prevent the widespread acceptance and use of ICES. However, their potential for inhibiting the commercial success of ICES is real, and they deserve more specific attention as the design of ICES hardware progresses in the future.

The following is a list of the major barriers to the implementation of ICES and related energy-efficient design concepts which have been identified in this report. They are discussed in more detail in Section 3. No attempt has been made to rank or weigh them against one another. Recommendations for further commercialization research also are included.

1. *Land Use Policy Changes* -- Proposed changes in public policies regarding acceptable mixes of different land use, especially when incorporating ICES in restrictive residential communities, will encounter moderate-to-heavy resistance. Demonstrated performance of the successful operation of new energy technologies will be necessary to overcome these barriers.

2. *Information for Decision Making* -- The lack of baseline energy consumption data at the community level is a serious constraint to public decision making in the field of energy conservation. Also lacking are data on relative efficiencies of public institutions to make energy-planning decisions. ERDA is currently moving ahead with some basic research efforts in comprehensive energy planning. To facilitate the acceptance of ICES, however, further attention should be directed at selecting energy-efficient site design alternatives.

3. *Fragmentation of Public Institutions* -- The sheer number of local jurisdictions with which ICES developers must deal is a hindrance to widespread standardization of ICES hardware and related site design concepts. Each project will have to be tailored to some extent to the needs and requirements of individual communities. However, massive public education and information programs will help to reduce public resistance among public institutions.

4. *Administrative Implications of Flexible Regulations* -- Flexible land use regulations, which are the most amenable to the implementation of innovative energy technology and community design, also impose the highest administrative costs on both developers and public institutions. In tight financial markets, these added costs could stop development. Substantial research efforts aimed at designing streamlined administrative and regulatory procedures are needed to keep such impediments to a minimum. Research efforts should include designs of the necessary performance standards, review guidelines, and model ordinances.

5. *Interdepartmental Coordination* -- Public decisions on ICES will require a considerable degree of interdepartmental coordination and agreement among the many fragmented, single-purpose, public service agencies commonly found in most local governments. Both technical problems (such as the integration of various utilities within common corridors) and administrative coordination of project reviews are potentially serious barriers to the success of ICES. As the appropriate mix of integrated utilities becomes clearer to the designers of ICES, research and demonstration efforts will be instrumental in resolving technical, interdepartmental conflicts and coordinating review procedures.

6. *Rigidity of Conventional Zoning* -- In addition to the administrative problems posed by heavy reliance on flexible zoning techniques, the rigidity of conventional zoning ordinances and subdivision regulations constitutes a substantial barrier to ICES because such regulations are still the predominant form of local land-use controls in most communities. To date, flexible zoning techniques have been used only on a voluntary basis and only in certain zoning districts. Research efforts aimed at designing and demonstrating the utility of flexible variations in conventional land-use controls will help to alleviate this problem.

7. *External Effects of ICES* -- To the extent that the objectives and performance characteristics of ICES conflict or work at cross purposes with other community goals and objectives (e.g., in such areas as growth management, housing equity, and environmental quality), the external side effects of ICES will constitute barriers to their acceptance. Although preliminary findings indicate that the major goals of ICES are compatible with other community goals, much more research will be necessary along these lines as the specific characteristics of ICES become clearer.

8. *State Utility Regulations* -- Whether ICES will be classified by state regulators as public or private utilities will substantially affect the administrative complexity of their operations and responsibilities. The Illinois Commerce Commission regulations would appear to classify ICES as a public utility (unless municipally owned), and consequently they would be subject to all the responsibilities and restrictions that accompany that designation (including responsibilities for the provision of adequate utility services at just and reasonable rates, controlled rates of return on investment, and other restrictions governing discrimination in service, abandonment of service, and liabilities). Potential owners of ICES include municipalities, existing utility companies, developers, and the energy consumers themselves (e.g., homeowners). State rulings on how ICES are classified will affect the ability of these various potential owners to operate and manage these systems over a long period. The administrative, financial, and technical capabilities necessary for successful ownership and maintenance of ICES are a crucial factor to their ultimate success -- a factor that needs more attention.

4.3 CONCLUSIONS AND RECOMMENDATIONS FOR PRIVATE INSTITUTIONS

4.3.1 Building Code Approval

ICES designs and components may involve materials, equipment, or construction techniques that do not meet building code standards. These potential conflicts should be analyzed and the process of code approval initiated in the early stages of project development. As soon as the technical and architectural specifications of ICES projects are known, any necessary code alterations must be submitted to the national model code associations. A minimum of one year is required for these associations to approve changes in the model codes. Specific

plans to undertake development of ICES projects must involve submission of the construction plans to the local code authorities. Code changes at the local level often require several months.

4.3.2 Exacting Performance and Impact Studies

The development of ICES project designs must include demonstrating the exact performance characteristics of the system and its community and environmental impacts. It is not uncommon for the processes of legal and administrative approval for new developments to take several years. These processes will be aided by the early and forceful demonstration of the advantages of ICES over conventional development projects. Sustained educational and public relations efforts by the developers (or by governmental agencies such as ERDA) will help to achieve public recognition and support, and facilitate administrative approval.

4.3.3 Industry Acceptability

The major trade associations within the building industry should be encouraged to participate in the development of ICES project plans. Organizations such as the AGC and NAHB are sources of expertise and resources in the construction industry. Support from these and other trade associations would aid in achieving both governmental and public approval of ICES projects. Professional associations such as ASHRAE can aid in the design and testing of components. Approval by such groups often is essential to obtain building permits or to initiate changes in building codes. Opposition to ICES projects by any of the major trade or professional associations in the construction industry would be a major disadvantage. These groups must be urged to participate during all stages of project development.

4.3.4 Labor Support

ICES projects must seek support from the major trade union organizations in the construction industry. Opposition from the Building Trades Council of the A.F.L.-C.I.O. would be a major disadvantage. Support from this organization, however, would encourage industry, governmental, and public approval. On the project level, construction plans should be presented to the labor organizations before construction commences to prevent jurisdictional disputes

among craft unions. Necessary labor training programs also should be organized before construction.

4.3.5 Marketplace Attractiveness

The activities of realtors, real estate appraisers, and lending institutions can be crucial to the commercial acceptance of any development. ICES projects should approach these groups to seek support and lessen existing hindrances. Realtors and appraisers must be encouraged to include energy-system characteristics in their assessments and market-evaluations of buildings. Lending institutions should be encouraged (or required by government) to take maintenance, energy-usage and life-cycle costs more fully into account in determining construction financing and in evaluating loan applications. The current practices of F.H.A., V.A. and most private lending institutions do not give sufficient encouragement to more energy-efficient developments.

4.4 CONCLUSIONS AND RECOMMENDATIONS FOR CONSUMER ACCEPTANCE

4.4.1 Consumer Acceptance

The acceptance of ICES projects by consumers in the housing market can be encouraged through a number of means. The appeal of planned community developments should be broadened to be attractive to more segments of the American public. The attractiveness of ICES projects depends on providing an unusual and highly attractive set of amenities or economic benefits. The development must consciously attempt to achieve high levels of consumer and resident satisfaction. ICES projects must be made as flexible as possible to appeal to different underlying values in American society. The external effects of ICES must be minimized, while the economic, energy-related and community-level advantages must be fully demonstrated.

4.4.2 Encouraging Social Change

The ICES Project cannot be seen as one of merely technological development. Housing patterns and the provision of necessary utility services are related to existing social practices and conditions. Programs that attempt to encourage technological change must be accompanied by provisions for social

change. The ICES program must attempt to encourage certain incremental changes in housing patterns, community structures, and in the public attitudes surrounding the provision of utility services.

APPENDIX A

AN OVERVIEW OF THE COMMUNITY DEVELOPMENT PROCESS

The Community Energy Systems Commercialization Project
Argonne National Laboratory

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APPENDIX A

AN OVERVIEW OF THE COMMUNITY DEVELOPMENT PROCESS

A.1 INTRODUCTION

Building a community requires a sequence of decisions made over an extended time by many participants. In the context of the Community Systems Program, the term "community" refers to a large development project (such as a planned unit development) which is bounded in purpose and physical extent and whose development takes place within a relatively fixed time frame under unified authority. Communities, large enough to be candidates for systematic, internal supply of energy services, will be subject to a complex and diffuse decision-making environment. This report investigates the major features of the community development process.

Several characteristics of development decisions should be stated at the outset. The decisions are usually *ad hoc*, because each project represents a unique combination of site, facilities, institutional structures, and purpose. It is not possible, therefore, to ascertain a single decision structure applicable in all details to every project or a fixed set of decision rules followed by each participant in the process. Often decisions are also made on the basis of acceptability criteria, without making concerted efforts to arrive at optimum choices. In all likelihood, the results of the decision process will change as the criteria applied by various decision-makers change to meet their current needs. The assumptions made in this report, however, are twofold: (1) in basic structure the decision-making processes for many kinds of community are similar enough to be proper subjects for systematic study; and (2) the structure will reveal the critical decisions that can affect the chances of success for community energy systems.

A.2 DESCRIPTION OF THE DEVELOPMENT PROCESS

At the scale of development we are addressing, development projects pass through several distinct phases, as indicated by Fig. A.1. In the first phase, the concept of the project is formed and tested for feasibility. Preliminary market, financial, and design analyses, tentative site selection, preliminary planning and design, and review of the institutional context are undertaken. For small developments, feasibility may be determined large-

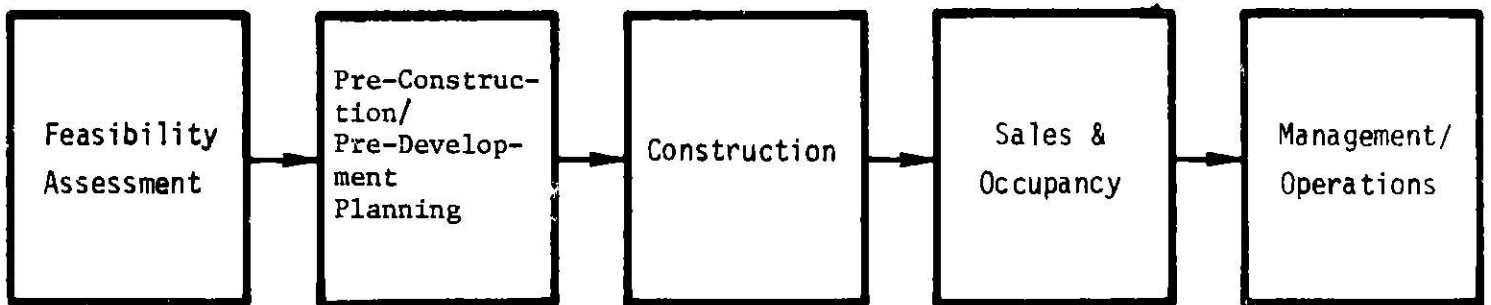


Fig. A.1 Major Phases of the Development Process

ly intuitively, but most projects usually require a more formal analysis. An affirmative outcome from the feasibility assessment leads to the second phase -- pre-construction/pre-development planning. Acquiring control of the selected site is one of the first actions required in the active project planning phase. Site and structure design and engineering will proceed toward final construction documents. Public review and approval of the plans for compatibility with public plans, zoning, and subdivision regulations will occur concurrently. Financial arrangements for land and construction costs also will be completed before the pre-construction phase closes. Next comes the construction phase which involves the assembly of a work force that includes a variety of building skills. This phase often is handled by a general contractor who supplies the management capability required to complete the construction on schedule. Public involvement in the construction phase is maintained to ensure that building and health codes are met and that the project is in general compliance with the approved plans.

For many purposes, discussion of the development process can be concluded at the end of the construction phase. The project's success is only subsequently proven, however, and an examination of the later phases of the project should be carried through to discover any additional factors that might threaten the overall acceptability of energy-efficient community concepts. The first post-construction phase is occupancy (phase four) of the completed structures. If a change in ownership occurs, marketing might become an important activity. The quality of the market analysis that was part of the initial feasibility assessment will become apparent at this time. After initial occupancy, the project enters phase five, management/operations -- its period of useful service -- which is the longest of the five life-cycle phases. Operating characteristics, reliability and ease of maintenance, liability for damage or injury resulting from design, construction or maintenance deficiencies, and responsibility for payment of needed public services will be important during the life of the project. These might become problems if they are not adequately addressed in the planning stages of the project. The project's useful life may end when it can no longer accommodate its original function or be operated economically. Rehabilitation, changes in use, demolition, and redevelopment are possible future scenarios for the project and the land beneath it.

	<u>Feasibility Assessment</u>	<u>Pre-Construction/ Pre-Development Planning</u>	<u>Construction</u>	<u>Sales and Occupancy</u>	<u>Management and Operations</u>
<u>Development Team</u>	Developer Planners and Consultants Architects and Engineers Lawyers Title Companies Soil Tests Market Research Sales and Management Agents	Developer Planners and Consultants Architects and Engineers Lawyers Title Companies Surveyor Pre-Leasing and Sales	Developer Architects and Engineers Contractors Subcontractors	Developer Lawyers Title Companies Marketing Consultants Sales Agents	
<u>Financial Institutions</u>		Lending Institutions FHA, VA, or Private Mortgage Insurance Companies	Lending Institutions	Lending Institutions FHA, VA, or Private Mortgage Insurance Companies	Lending Institutions
<u>Public Institutions</u>	Zoning and Planning Officials Annexation Processes	Zoning and Planning Officials Sanitary Districts School Boards Fire Districts	Building Code Officials Health Code Officials		Zoning and Building Officials Tax Assessors
<u>Private Institutions</u>			Craftsmen and Their Unions Insurance Companies		Repairmen, Craftsmen and Their Unions Insurance Companies
<u>Consumer</u>				Owners Tenants	Owners Tenants
<u>Supply</u>	Land Owners	Land Owners Real Estate Brokers	Materials/Equipment Manufacturers and Distributors	Real Estate Brokers	Materials/Equipment Manufacturers and Distributors
<u>Management/Operations</u>					Property Management Firms Utility Companies Maintenance Firms Architects and Engineers Contractors Subcontractors

TABLE 1 Institutional Roles Filled During Several Development Process Phases

The diagram in Figure A.1 is only a coarse starting point in a structuring of the development process. The actual process is neither so straightforward nor so neatly compartmentalized. Activities are likely to be proceeding along several paths simultaneously without necessarily coming together at a single point that can be identified as the transition between two project phases. For example, the transition between feasibility assessment and active preconstruction planning might be difficult to ascertain; some financial and market assessments might continue while land assembly and preliminary planning and design have already begun. Furthermore, large projects may be built in stages, over many years, by several developers. For clarity of organization, however, the more detailed discussions to follow will continue to utilize the basic structure of Figure A.1.

To be fully useful in tracing some factors affecting the acceptance of community energy supply systems, a discussion of each development decision must be accompanied by an examination of the agent or actor who is responsible for making it. The actors can be defined by functional responsibilities in the development process. It is possible, of course, for an individual or organization to fill several functional roles. For example, the developer might be the original land owner and also own and manage the completed project. The decisions made for a project reflect the nature of the organizations that play various development roles. Table A.1 lists the actors that will participate in each of the five project phases. These roles have been grouped into six external factor areas plus the central developer function. In a later elaboration of each project phase, the actors will be associated with the individual development decisions for which they are responsible.

Before proceeding to the more detailed discussions of each project development phase, several points about this report should be made clear. First, its purposes in the Commercialization Study are to provide a systematic structure that will help ensure that all major factors are considered, and to give some insight into the interrelations of factors. The report, based on a relatively limited set of source materials that is biased toward residential and suburban development, treats the process through the construction phase much more fully than the occupancy and service phases. However, the discussion will include some cases where there is some evidence that the process might vary for the development of the larger communities in which we are interested.

A.3 PHASE 1 -- FEASIBILITY ASSESSMENT OF POTENTIAL DEVELOPMENT PROJECTS

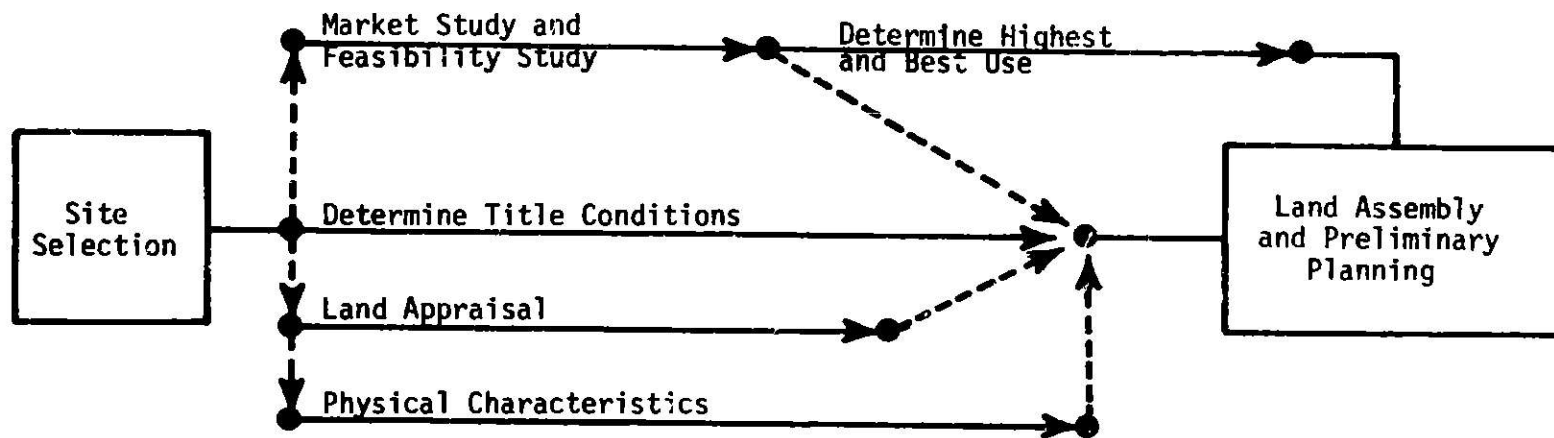
The activities in the feasibility assessment phase of the construction process can be considered as directed toward reaching decisions about what to build and where to build it. The developer, as entrepreneur, plays a major role in these decisions which set the course for the proposed community; most other participants fill only advisory roles.

In an abstract sense, phase one is represented by a comparative evaluation of alternative development possibilities located on available building sites to yield the one that will best satisfy the developer's objectives. Although there may be many possible alternatives, a developer can afford to review only a few candidates in detail. If he already has control of the site, his concern will be to choose the most suitable uses and development intensity. He might specialize in the construction of a particular type of project, e.g., shopping centers, so that his primary concern is with the choice of the best site for such a purpose. Intuitively, the developer generally limits his assessment to the few, most promising development opportunities.

A.3.1 Elements of a Feasibility Assessment

In broad terms, the elements of assessing the development of a chosen site will include those diagrammed in Figure A.2.¹ Analyses of the physical and legal characteristics of the site are combined with market and other feasibility studies to yield a decision as to whether to proceed with acquiring control of the site (i.e., land assembly). The feasibility studies -- the essential prelude for preliminary planning -- also determine the best use of the site.

A flow of the considerations leading to the decision to invest in a particular site is detailed further in Figure A.3. This diagram² originally was prepared as a model of the behavior of moderate-to-large residential developers (constructing between 20 and 300 dwelling units per year) engaged in land development and the construction primarily of single-family tract houses. Although it is not a general model of feasibility assessment, it illustrates the form taken by some feasibility elements in a specific application. Once a site is under consideration by these developers, a feasibility study is carried out to assist in making the purchase decision. The essence of the



A.7

Fig. A.2 Elements Used to Assess the Development of a Site

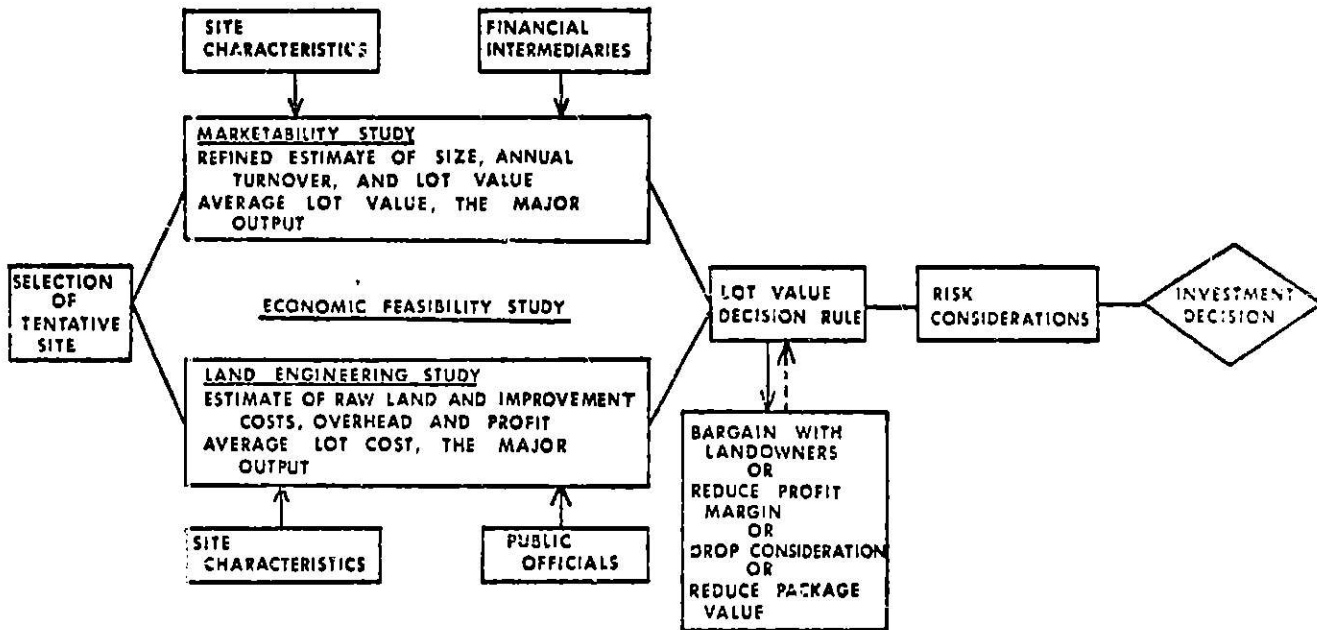


Fig. A.3 Site Decision Process for Residential Development

feasibility determination is a comparison of potential market values and costs of developed building sites in the community (i.e., an estimate of profitability), combined with an estimate of marketability of the finished package as gauged by the anticipated turnover rate. Site characteristics enter into both the output value and the cost estimates. Locational characteristics (including accessibility to schools, employment, and shopping) and natural amenities of topography and vegetation affect the potential value of units on the site. Improvement costs also are affected, however, by such site characteristics as the topography, soil conditions, and existence or absence of streets and utilities. The feasibility study takes into account the probable actions of several groups whose approval is essential for the success of the projected development. General concurrence by financial intermediaries with the estimated marketability of the completed development must be assured before the developers surveyed were usually satisfied with a development's feasibility if it could be shown to meet the requirements for insurers and guarantors of the financing, especially the Federal Housing Administration and the Veterans Administration.³ Local government through its planning, zoning, and plat review regulations, public works, and utilities services departments will have an impact on the costs of the development. Frequent contact with public officials is required during the feasibility phase.

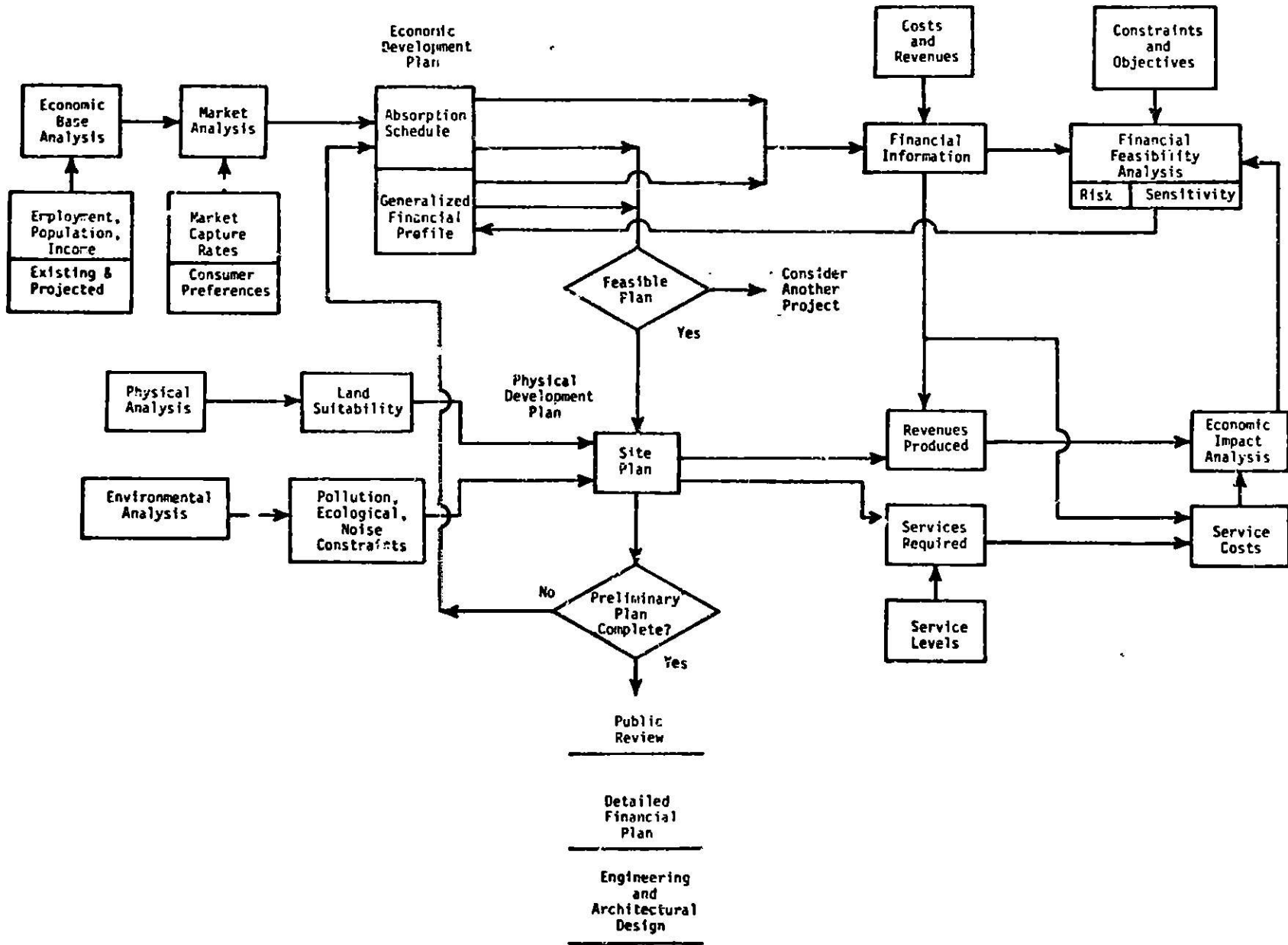
A.3.2 A General Feasibility Assessment Model

A feasibility study will almost always become more structured with increasing size and complexity of the projected development. A small residential developer might make an intuitive judgement of feasibility based on a few sensitive indicators, but the corporations engaged in large-scale land development will require much more tangible estimates of the prospects for success of the proposed projects. More systematic analysis may be required to make explicit, and to some degree controllable, the complex interdependencies of the many project elements of a large-scale project. Despite efforts to minimize the risk of overlooking some vital aspect of the project, absolute assurance of success cannot be provided. The developer's ability to gauge trends, to supply correct assumptions, to make timely decisions, and even to break with tradition at the proper moment are still indispensable attributes and probably will continue to be so.

Several recent efforts have been addressed to the creation of computerized methods for the evaluation of the financial feasibility and risk of large-scale land development projects. These methods can: (1) reduce the manpower needed to carry out detailed evaluations, (2) analyze the effects of many variables, and (3) allow the consideration of a number of development alternatives. For purposes of this discussion, the internal structure of such a program is not so important as the way it is used in the initial assessment of overall project feasibility. The early stages of a development process might follow a flow similar to that diagrammed in Figure A.4, which is based on a report describing the application of a computerized financial feasibility and risk analysis model.⁴ The feasibility analysis is embedded in an economic and physical development planning process. At the core are the economic and physical development plans that are initially highly fluid and imprecise, but through evaluations of public acceptance (of both the development and its impacts) and financial feasibility, the plans are progressively made more concrete. The development flow in Figure A.4 assumes the prior site selection and is directed toward the determination of the best use of that site.

The preliminary plan, including an absorption schedule of the development -- an approximate determination of what is to be built, how many, at what price, and in what time frame -- is the result of a market analysis that combines total regional building requirements and an estimate of the capability of capturing portions of the various building markets at the site. Financial information, derived from the absorption schedule with the application of unit costs and revenues, provides a principle input for the financial feasibility analysis. Zoning regulations and available interest rates are typical constraints that affect the development's feasibility. The developer's objectives, including the desired build-out term and rate of return, also must be considered. Because the factors involved in the analysis generally are not precisely known or fully predictable, uncertainty is added to the results. This uncertainty can be explicitly dealt with by the assignment of most likely values and ranges, rather than single values, for the uncertain factors in the analysis. Some assessment of the overall risk then can be carried out. With automated techniques, alternatives can be considered in which factors are varied to determine the sensitivity between the values assigned to the factors and the overall financial results. The results are

Fig. A.4 A Generalized Feasibility Assessment Process



a series of financial profiles that will include an income and cash flow statement showing the financial position of the project for each year of its development. If the results are considered feasible, more detailed physical planning can proceed and physical and environmental analyses of the site will be used to begin to transform the absorption schedule into a site plan. The community economic impact that results from a comparison of public revenues produced and costs for service required is an additional consideration that must be factored into the economic feasibility analysis. This impact will have a bearing on the degree of acceptance that can be expected from the surrounding community.

The process shown in Fig. A.4 blends almost imperceptibly into the following phase of the total development process. There is no identifiable single decision that transfers the developer to some wholly new kind of activity. Physical and economic development planning will continue, with emphasis on engineering and architectural design and on the formulation of a detailed financial plan. These efforts and the formal public review of the plans will be discussed in section A.4.

A.3 3 Energy Considerations During the Feasibility Phase

The activities and decisions described as part of the feasibility assessment for a development project are nearly all made by or under the control of the developer. Energy considerations historically have not been important at this stage. Development usually takes place in an area served by an existing utility which generally has the capacity to supply the project. However, some early planning has energy implications. The locational decision has access as one of its determinants. This affects transportation and therefore energy. Because it will become an element of the urban activity pattern seen by future developers, the location of one project will have continuing impact on changes in transportation energy consumption. The preliminary project plan also has implications for energy consumption. For a planned unit development, for example, the basic energy consumption patterns will be determined by the mixture of dwelling units, the level of shopping opportunities to be provided, and the tentative determinations of overall development density and internal variations in density (i.e., clustering). More conscious later efforts at reduction in energy consumption through optimiza-

tion of the urban design and technological facilities of the development will work from the baselines set by these early decisions.

A.4 PHASE 2 -- PRE-CONSTRUCTION/PRE-DEVELOPMENT PLANNING

A.4.1 Activities Carried Out in the Pre-construction Phase

Although the pre-construction process for large-scale developments is as varied as the developments themselves, certain procedures are followed, to some extent, by every developer. The list of procedures in Table A.2 is the result of one attempt to itemize the general pre-construction procedures.⁵ The first and last procedures in the list establish the overlap with the preceding (Feasibility Analysis) and succeeding (Construction) major phases of the construction process.

One way to view the pre-construction activities in Table A.2 is to consider first the programmatic areas that are involved and then to elaborate on the separate tasks that must be performed in each area. Several important programmatic areas are listed in Table A.3. There is a correspondence between the activities carried out in each programmatic area and the sequence of procedures that represents the entire pre-construction process. From a general understanding of what is involved in a financing program, for example, it seems clear that planning the development, obtaining loan commitments, and closing loans each will be related, at least in part, to financing. Table A.3 shows the correlation among the procedures of Table A.2 and each programmatic area. Only procedures two through ten are considered to be part of the pre-construction phase. It should be noted that, except for "planning the development" (procedure 3), all other procedures appear in only a single programmatic area.

The level of interaction between the developer and external groups over which the developer has no control, e.g., governmental agencies, varies within such a set of programmatic areas as given in Table A.3. Project programming and design and engineering are, to a high degree, under the control of the developer, whether the tasks in these areas are carried out within his own organization or by consultants. These might be thought of as the mainstream of preconstruction development activities. Project scheduling is one mainstream activity that is being increasingly affected by the environ-

mental movement, government regulations, and the economy. The programmatic area of land acquisition requires agreement between the developer and the land owner. Control of the land usually occurs early in the preconstruction process. In the other three programmatic areas, major decisions are not controlled by the developer. The renter or buyer makes the ultimate leasing/sales decision; lending institutions control the outcome of the financing program; and government bodies determine that subdivision, zoning, and building code regulations will be met by the proposed development. The government also agrees to make public improvements in some cases and to provide public services.

TABLE A.2 Procedures Followed in the Pre-construction Process

1. determining the type of development to be constructed,
2. assembling the land for the development,
3. planning the development,
4. obtaining tenants when appropriate,
5. developing the site plan,
6. obtaining loan commitments,
7. obtaining legislative approval (e.g., zoning),
8. developing construction drawings,
9. closing loan contracts,
10. buying land, and
11. commencing construction.

TABLE A.3 Performance of Pre-construction Procedures by Program Area

<u>Program Area</u>	<u>Procedures</u> ^(a)
Financing Program	3, 6, 9
Public Relations; Rental/Sales	3, 4
Project Programming	3
Design and Engineering	3, 5, 8
Land Acquisition	2, 10
Zoning/Code Approval	7

(a) Procedures are referred to by the numbers for them in Table A.2.

A.4.2 Chronological Ordering of Pre-construction Activities

Procedures listed in Table A.2 are roughly in the chronological order in which they typically are carried out. Figure A.5 details the individual tasks that are conducted within each of the six programmatic areas, together with the interrelationships among all the tasks and, hence, among the programmatic areas. The flow of tasks is from left to right, proceeding from preliminary planning activities through the final step before actual construction. At the level of detail shown, the description is approaching the limits of what can justifiably be called a generalized diagram of the development process and is taking on characteristics that are related to the specific conditions of a single development project. The leasing/sales program pictured is appropriate for a large commercial center. It is also assumed that some of the public review process can proceed simultaneously with the preparation of the final site plans. The zoning/code approval program might look somewhat different if rezoning or annexation of the site were required or if the development were a large residential subdivision requiring both a preliminary plat approval based on a sketch plan and a final approval of the developer's final plat.⁶ Large developments frequently require state and/or federal environmental impact statements. If the project were to be built in part with federal funding, A-95 review procedures also would have to be observed.

There are implicit assumptions in Figure A.5 about the developer's mainstream programs. The traditional sequence of activities for small projects is a linear progression from programming through planning and design to the construction of the project. This is shown in diagram A in Figure A.6.⁷ In the process represented by Figure A.5, however, parts of these activities overlap. In particular, one preliminary stage has programming, planning, and design being carried out simultaneously. The telescoping of pre-construction activities and the kind of overall time savings that can result is indicated schematically in Figure A.6B. Each of the major tasks has been broken into subtasks so that, where possible, succeeding tasks can be started on the basis of preliminary results. Project scheduling tools, such as the Critical Path Method (CPM), are being adopted by the construction industry, and construction management is increasingly used. Some further aspects of construction management are discussed in Section A.5.

The procedures diagrammed in Figures A.5 and A.6B keep pre-construction and construction activities separate in time. However, programming, planning,

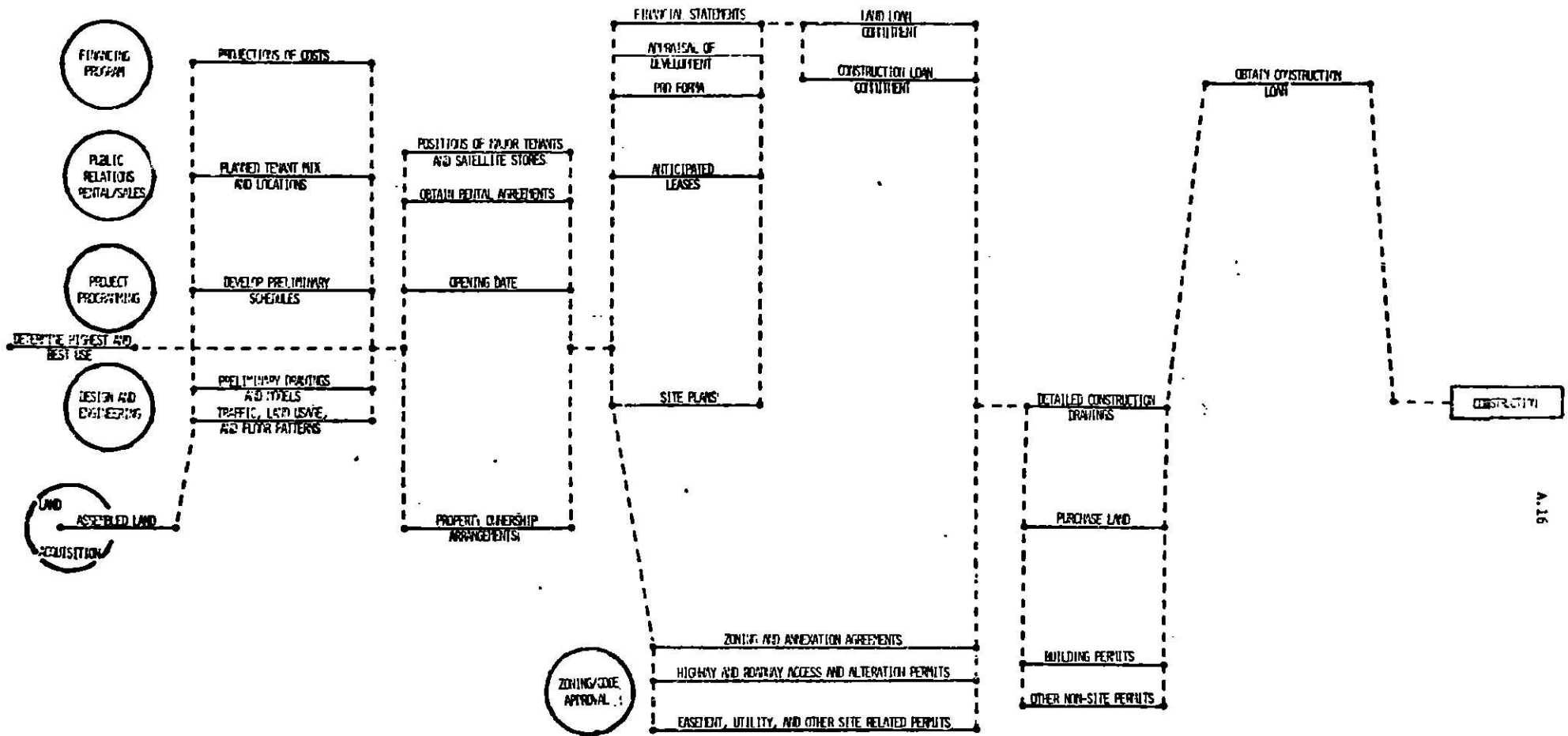
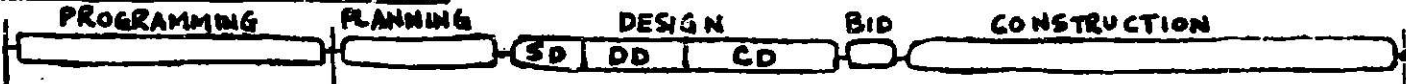
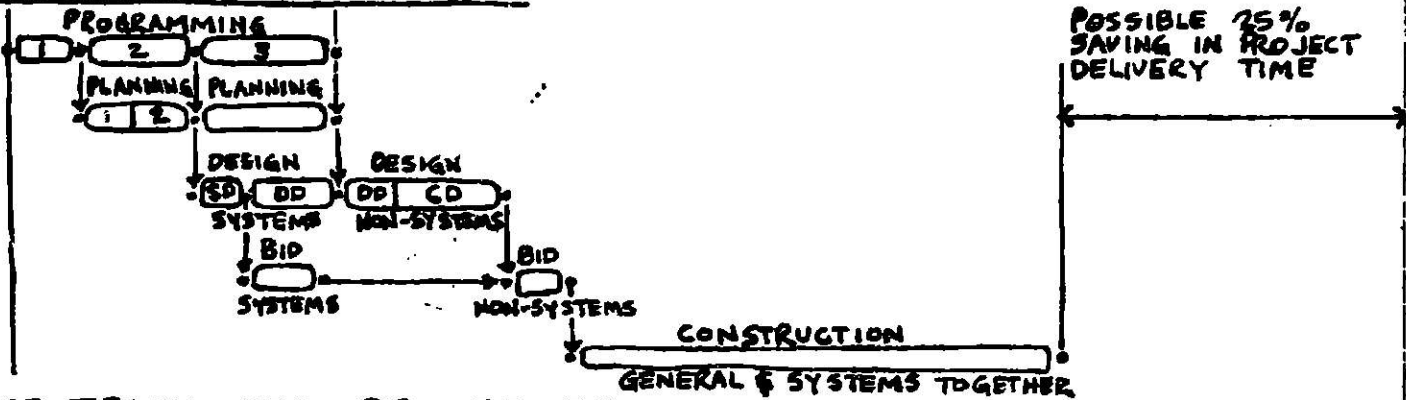


Fig. A.5 Flow of Tasks from Preliminary Planning Activities through Final Step before Construction

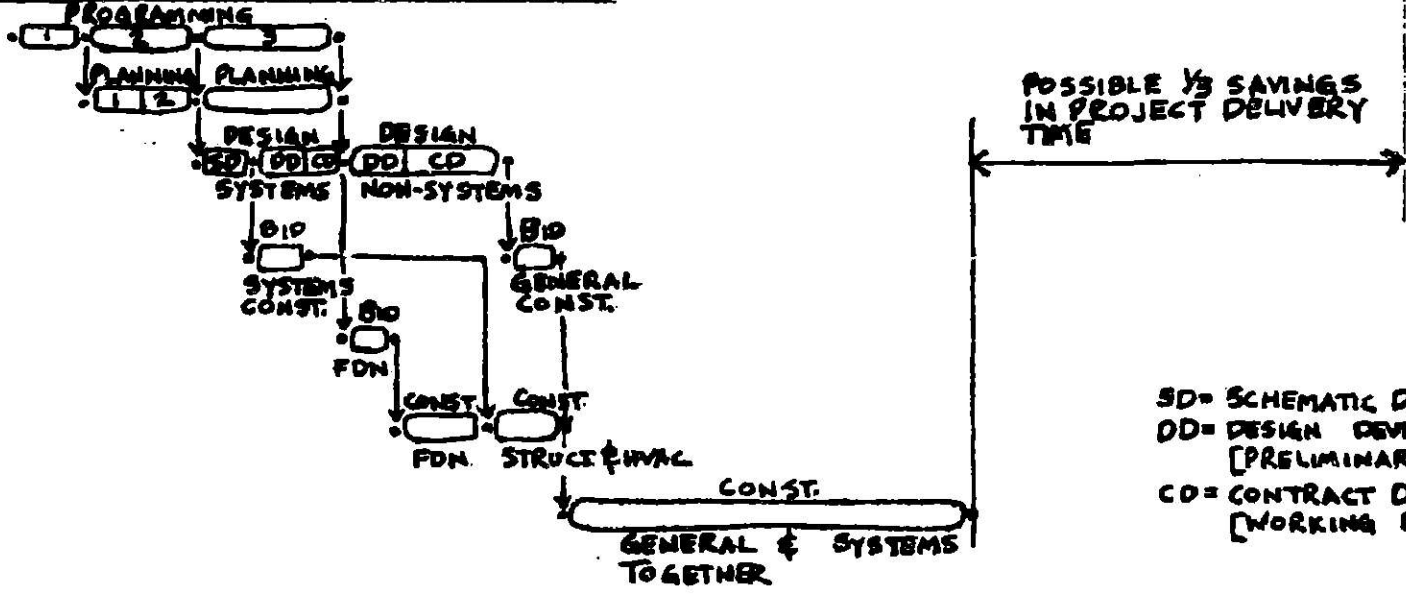
A. TRADITIONAL PROCEDURE



B. EARLY SSP PROCEDURE



C. FAST TRACK SSP PROCEDURE



SD = SCHEMATIC DESIGN
 DD = DESIGN DEVELOPMENT [PRELIMINARIES]
 CD = CONTRACT DOCUMENTS [WORKING DRAWINGS]

Fig. A.6 Project Management Procedures for Achieving Savings in Project Delivery Time

and design work on one or more building components may be completed and construction begun while the pre-construction activities for other components are still in progress. This could result in further reduction of the overall project delivery time, as shown in Figure A.6C. The incentives for shortening the time required for completion of a large-scale development project include lower cost (e.g., less construction interest) and earlier return on investment. The length of the time interval between the initial investments and significant returns from completed portions of the project can be crucial if the project is to succeed.⁸ Any techniques, such as "fast tracking", that can reduce development time will increasingly be used.

In focusing attention on methods to speed up the mainstream activities, one should not lose sight of the necessity to ensure that the required ancillary procedures can be accommodated within the new schedules. Uncertainty in the time required for the public review process, in particular, can threaten the most sophisticated attempts to streamline the development process, and this uncertainty is surely greater when the review includes new and complex design concepts and energy technologies.

A.4.3 Some Pre-construction Decisions Affecting Energy Consumption

Major decisions determining energy consumption are made in the pre-construction phase of the development process. The design of the structures, their operating systems, and their siting within the development are major concerns during this phase, and each has an effect on the energy ultimately consumed in the development. Systems for meeting end-use energy demands and for supplying the overall energy requirements are chosen on the basis of anticipated use patterns, required systems reliability, equipment costs, and operating costs. In the balance that is struck among all the factors contributing to the evaluation of alternative designs, energy consumption traditionally has been given a relatively low weighting. With increases in the cost of energy and uncertainty about the continuing availability of some fuels, energy considerations are now receiving higher priority. Institutional factors also can have an effect, and the developer's understanding of the response that the designs will elicit from consumers, public review bodies, and financial institutions is added, in perhaps a more intuitive fashion, to his overall evaluations of the designs. The degree of importance attached by a developer to these external responses is not always clear, but obvious sig-

nals from the groups regarding their probable response to innovations for energy conservation certainly will not be ignored.

A.5 PHASE 3 -- CONSTRUCTION

The construction phase of many projects focuses on an organization that may not have participated earlier. Although some large development firms do general contracting, most developers use an independent general contractor. The general contractor "provides the building service: i.e., he plans and supervises the construction, purchases materials, and hires workmen or subcontracts parts of the job."⁹

A.5.1 Construction Management

The customary arrangement between a developer and a contractor is a lump-sum contract awarded on the basis of competitive bidding. Other possibilities include a lump-sum contract arrived at through negotiations with a sole contractor, and contract payment on a cost-plus, fixed-fee basis. Public agencies usually are required to use competitive bidding for their projects. Projects for which construction costs are especially difficult to predict (e.g., those requiring many untried construction procedures) might be built on "cost-plus" contracts. Although a variety of contractual arrangements exists, the bridge between the pre-construction and construction phases of the development process can be illustrated by the activities making up the competitive bidding process, as shown in Fig. A.7. The concluding activities of the pre-construction phase, at the left of the diagram, result in the construction documents on which the contractors bid. At the opposite end of the sequence, as a first major activity, the successful bidder will conduct a detailed analysis to plan the construction.

Depending on the complexity of the project, the process of planning the construction may be carried out more than once -- for differing purposes and at differing levels of detail.¹⁰ An initial effort to establish basic construction planning for the project might be accomplished by the developer as one of the steps in preparing the bid package or by the contractor in arriving at his bid. The developer might use the results to determine reasonable construction time as part of the project specifications. Because contractors generally are successful in less than a third of the projects on

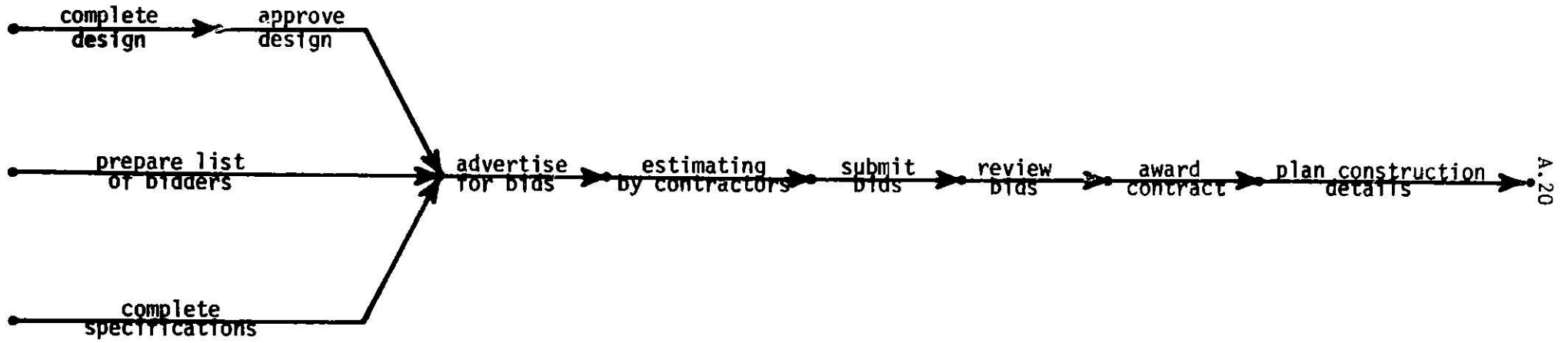


Fig. A.7 Activities Making Up the Competitive Bidding Process

which they bid, they are forced to limit the level of effort devoted to any single bid preparation. However, the pre-award planning should serve as the basis for preparing the working schedules following receipt of a contract. Furthermore, portions of the project that will be subcontracted might be subsequently planned in greater detail to ensure coordination among subcontractors.

The construction tasks can be grouped according to major project elements and arranged in a sequence reflecting construction logic. A first level of breaking down the construction process is shown in Fig. A.8, in which construction is seen as involving such basic task aggregations as building the foundation. To be of value for a specific project, "Foundation" and each of the other blocks needs to be examined much more closely to see how it will actually be accomplished. This pyramidding expansion of the project description¹¹ might lead to a diagram such as that shown in Fig. A.9, which is an illustration developed by O'Brien for the construction of a hypothetical combination plant-office-warehouse for a small industrial firm.¹² The activities included in Fig. A.9 comprise several individual tasks, as is apparent when one tries to visualize the steps necessary to erect structural steel (activity 29-30). In level of detail, Fig. A.9 might be the first network of the construction formulated by the contractor immediately after being awarded the contract. In some instances, this much detail might be useful in making the bid estimates. However, it probably would not be the final level of description.

The kind of project analysis represented in Fig. A.9 has come into use by large contractors with the evolution of CPM and Program Evaluation and Review Technique (PERT) in the last 20 years. These network-based planning methods have proved to be highly effective in making decisions for the efficient allocation of construction resources. With estimates of the times required to complete the individual activities, a logical network, such as that in Fig. 9, becomes a tool for establishing the project schedule. Among the activities simultaneously under way, some can be completed more quickly than others, and the overall time requirement for completing the project is determined roughly by a path through the network connecting the sequence of activities that will take the longest to finish. The activities on this critical path must be monitored closely if the project schedule is to be maintained. Through application of

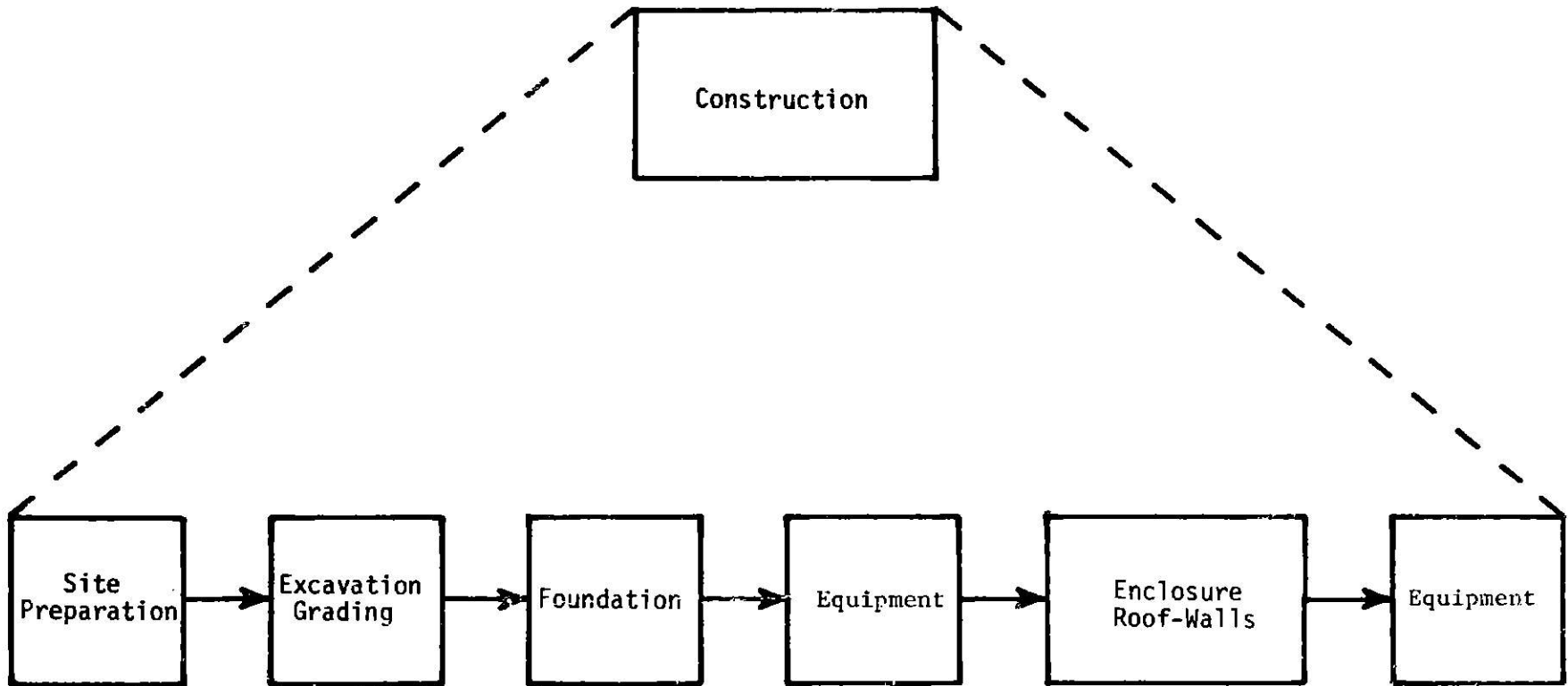
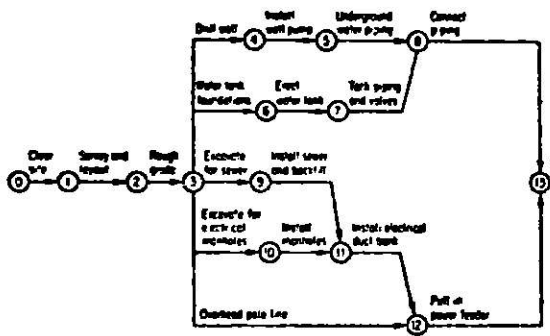
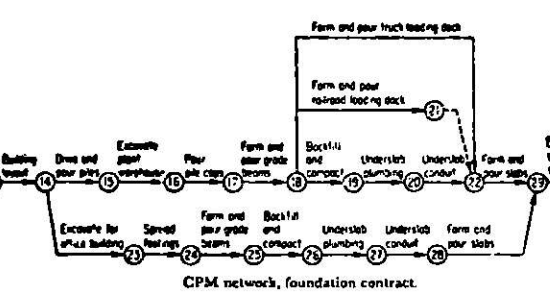


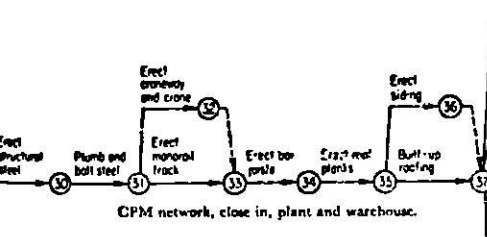
Fig. A.8 Major Construction Project Elements, Arranged in a Construction Logic Sequence



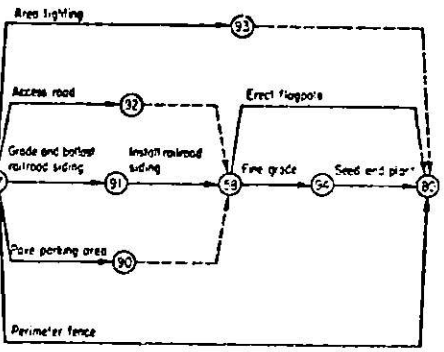
CPM network, site preparation and utilities.



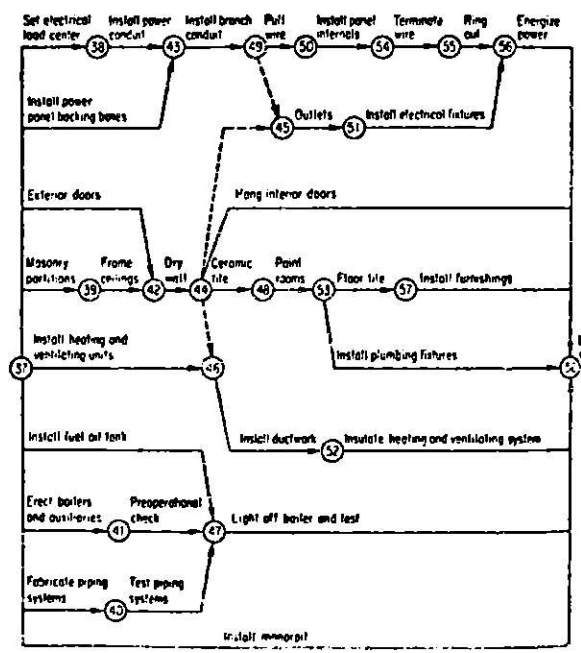
CPM network, foundation contract.



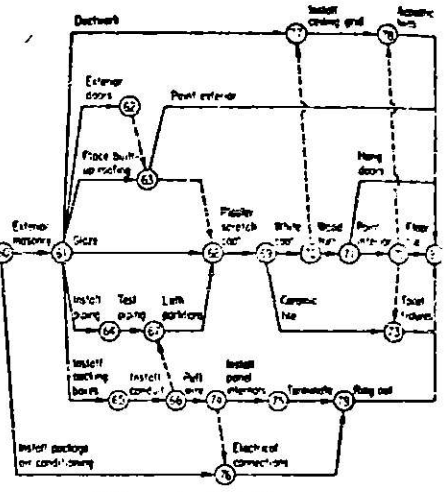
CPM network, close in, plant and warehouse.



CPM network, site work.



CPM network, interior work, plant and warehouse.



CPM network, office building.

Fig. A.9 Project Network as Illustrated for a Small Industrial Structure

other resource requirements for each activity, manpower and cost schedules also can be prepared. The cost schedule gives the developer some indication of the times at which payment will be required and permits him to manage the funds that have been allocated to the project. When added to the construction schedule, information about delivery times for materials and building systems such as HVAC equipment will assist in both timely placement of orders to suppliers and inventory management.

Because some choices usually exist in constructing a logical sequence of activities and in scheduling the non-critical activities, this flexibility can be used to accomplish the preferred construction objectives. Minimum construction time often is the principal objective, but objectives regarding manpower utilization and project cost can also be objectives.

The construction process is not as rigidly predetermined as the previous discussion might indicate. Several uncertainties, including weather conditions and strikes, make it impossible to predict exactly what will happen. The assessment of probabilities for the predicted values of major project factors is a capability that was initially developed as a part of PERT. The risk analysis which is part of the developer's feasibility assessment discussed earlier uses a similar kind of accounting for the effects of uncertainty. Even if the variables combine to invalidate the original construction plan, it will still serve as a structure for defining the current status and indicating the best revised course for completion of the project.

A.5.2 Institutional Interactions During the Construction Phase

Many interactions, some of which have been indicated, exist among the participants in the construction phase. Nearly all of these interactions involve the construction contractor because he is the pivotal participant during this phase. However, because primary decision-making responsibility remains with the developer, the developer and contractor maintain open communications throughout the construction. In some instances an architect or engineer might represent the developer in monitoring construction progress. Construction plans often have built-in milestones at which major portions of the project are to be completed. Reviews and approvals by the developer or his consultant of progress toward these milestones during the specified report periods comprise the bases for the periodic compensation provided (by the lender, unless the developer is self-financed) to the contractor.

The contractor also interacts with subcontractors, suppliers, and public officials. Subcontractors tend to engage in construction specialties, such as steel erection, electrical installation, and plastering. The subcontractors' tasks must be integrated into the overall project planning to ensure timely performance of those tasks. Therefore, subcontractors may be involved early in the project planning. If a choice must be made among different materials of closely equivalent price and performance, but available from different suppliers, the contractor might prefer to patronize a supplier with whom he is familiar and whose reliability has been proved. Because unit prices might be less for bulk purchases of materials, the contractor might also consider the costs of inventory management when a given material is purchased at one time for the entire project or several projects in comparison with the added cost of materials purchased in smaller increments as needed. Just as the contractor must have some way of verifying that the materials he uses meet design specifications, so he must also be able to satisfy building officials that the construction meets all applicable building requirements. Most contractors operate within a comparatively restricted geographic area and are familiar with the local building requirements.

Two additional interactions occur within the contractor's jurisdiction. Between the office and field elements of the organization there must be mutual understanding of the project's goals and the details of the construction plan. For smaller organizations the "paper-work" aspects of management and onsite supervision might be accomplished by a multi-talented manager for each project. When these functions are separated into job specialities -- e.g., to accomplish efficiency in larger organizations -- the necessity to ensure good communications among the functional areas becomes vital. The second set of interactions is between management and labor, with the construction trades unions as an effective participant through the establishment of union membership requirements and work rules. The planning goal of manpower leveling, that is, utilizing a nearly constant labor force, also meets some of labor's job continuity objectives. These objectives are made considerably more difficult to meet, however, when the labor force is highly fragmented with rigid jurisdictional boundaries among trade specialties.

A.5.3 Energy Conservation and the Construction Phase

Energy is one of the resources used during construction. Its use is indirectly tied to the overall management of construction resources, but minimization of its use has rarely, if ever, been an objective of a construction plan. The energy demands of the finished development are set by the project design which is usually completed before construction begins. This function of the design process can be compromised, however, by poor quality construction.

Innovative designs and building systems for energy conservation will emphasize some of the construction process characteristics mentioned earlier. Chief among these is the effect of uncertainty. Problems with unfamiliar construction techniques, uncertain delivery schedules for critical components, requirements for new buildings skills, and unresolved jurisdictional considerations among building trades make construction planning more difficult than usual. The planning methods described earlier include ways to evaluate the effects of uncertainty, but there is some tendency to apply these techniques conservatively, especially where the uncertainty is a measure of lack of knowledge rather than of known variability. Coordination among the various participants -- developer, contractor, subcontractor, supplier, labor officials, and public officials -- is essential for planning and successfully completing the construction, but it is harder to achieve under these circumstances. These considerations will affect the bid submitted by the contractor at the outset of the construction phase, and anticipation of them may influence the developer's design choices.

A.6 PHASE 4 -- LEASING/SALES/OCCUPANCY

Of the five phases of the development process diagrammed in Fig. A.1, Phase 4 -- Leasing/Sales/Occupancy -- is probably the one having the fewest directed implications for the energy consumption of a community. Getting the community into full operation is the primary concern of this phase. Continued occupancy of the community, however, falls within the Management/Operations portion of the community's lifecycle.

Although the actions taken during this phase do not affect the energy consumption of the community, they are not wholly insensitive to energy use and energy systems. Because energy conserving communities could vary well

require higher initial costs than the usual comparable community, the potential owners must be able to realize the advantage that can result from lifecycle costing. The degree to which lifecycle costing is likely to affect actions depends on the type of community and the type of owner. A study of the likelihood that one of several kinds of participant organizations would assume a role as owner/operator* of a Modular Integrated Utility Systems (MIUS)¹³ showed the importance of the organization's economic objectives. The study included different kinds of developers and utility companies. Among the three kinds of developers considered -- (1) governmental; (2) private, non-speculative; and (3) speculative -- the ability of the developer to take a long-term view of a project was judged the most important determinant of his willingness to be involved with a MIUS. On this basis, governmental developers are most likely and speculative developers least likely to be found among MIUS owner/operator.[†] The case for utility companies is somewhat more ambiguous because of the more regulated environment within which they operate; their economic time frame is not so clearly dominant a factor in their choices, or so greatly different for different kinds of utility companies. Most of these conclusions about the chances for different organizations to look with favor on projects involving MIUS should hold equally well for community energy systems. The approach used in the MIUS economic study can serve as a model to anticipate the likelihood that other organizations will be owner/operators of community energy system projects.

Although the importance of economic objectives is stressed, other criteria enter the decisions that lead to occupying the new community. For example, political, legal, and environmental criteria also interact with economic criteria in the decision process. Consumer response to an innovative project among available housing choices might be one case for which non-economic factors cannot be ignored. Innovation in this market could be a two-edged sword, with the positive potential of the distinctiveness of the innova-

*The role of owner/operator was distinguished in the study from the roles of institutor -- one who carries the project through the Construction phase -- and ultimate consumer.

[†]Speculative owners would be more cost-conscious and, therefore, more receptive to MIUS if energy costs could not be passed on to tenants. Speculative de-
velopers might try to entirely avoid becoming owners of projects in which costs could not be passed on.

tion being offset by a general resistance against any product outside the range of experience. The probable response within the chosen market was one of the factors discussed earlier that enters a developer's initial evaluation of the feasibility of the project, but it can involve a high degree of uncertainty for innovative projects.

A.7 PHASE 5 -- MANAGEMENT/OPERATIONS

A.7.1 Organizational Patterns for Management/Operations

The theme of the preceding section can be summarized as the importance of the attributes of individuals or organizations for determining which of them might become the owner(s) of an energy-conserving project. Organization attributes continue to be of importance after the community is operational, as seen in the filling of roles. Owner, operator, and consumer are three primary roles to be considered when examining the patterns of energy use. Ownership and operation of the energy systems within and/or servicing the community could be separate from all other aspects of the community, adding the possibility of filling two more roles. These five roles can be filled by a variety of combinations of possible participants, among which are real estate investors, management firms, utility companies, and owner's co-ops. The owner of a commercial development might be prepared to take on all of the owner/operator responsibilities, but if real estate investment is his sole objective, operation of the community and ownership/operation of the energy systems might be turned over to other organizations. In a residential area, the owners of individual units would also be the end-use energy consumers; ownership and operation of the common areas and utility supply systems might then be in the hands of an organization of the home owners, the local municipal government, a special utilities district, a private utilities company, or some appropriate combination of these and other groups.

A.7.2 The Significance of Alternative Organizational Patterns

A few examples of the significance of the organizational pattern in the operational phase of the community can be shown. The organizational pattern certainly will influence the level of experience that is brought to community management, its effectiveness, and perhaps even its degree of commitment. The owner/investor filling a management role and the association of independent owners are likely to have different styles and objectives from

those of a firm specializing in management. The organizational pattern is also important in defining the body of regulations that will be applied to operations of the community. If the community's utilities are operated in such a way that they meet the criteria for classification as public utilities, all of the state regulations pertaining to public utilities will become applicable. Among the criteria are the manner in which charges for utility services are determined and assessed and the extent to which the services are available to the general public. For example, shopping centers are a type of development for which a number of arrangements for supplying and billing utility services, with the tenants paying for services actually used; charges for services supplied from the total energy system might be prorated on the basis of floor area; the rental of space in the center might have a utilities charge built in; services might be supplied only to the smaller retailers and the common areas in the center, with the key stores handling their own service arrangements; or the supply of services might be provided by public utilities companies, independent of other aspects of management of the shopping center. Although management, market, and profit considerations determine which of these arrangements will be applied (the decision must precede construction of the center), the choice will have a bearing on whether the supply of services to the center will come under public utility regulations. The desirability of avoiding the regulations could be one of the factors in the decision. Considering the diversity of organization structures that can be applied in the operation of a large-scale development (especially, the arrangements for the supply of utility services) and the interrelation of the evaluation measures for them, it is apparent that the determination of the "best" organizational structure for a particular development is difficult.

The previous example of the various ways for supplying energy to a shopping center demonstrates that interactions with external groups also are a function of the organizational structure for the development. The manner of supplying services is an integral part of the organization of operations and is also a determinant of the extent to which the development will come under the purview of state bodies responsible for the administration of utility regulations. A more complex interaction with utility companies was implied in the example. In the set of cases given, the role of utility companies ranged from one completely outside the operations of the development to the opposite extreme of full responsibility for utility services. When it is outside the day-to-day operations

of the development, a utility company might still be relied on to provide backup services in the event of failure of the development's energy systems. The liabilities of the operator during outages of the primary systems, the arrangements for meeting claims arising from the liabilities, and the circumstances and charges for picking up backup service are some of the interesting aspects of this situation.

A.7.3 Maintaining an Acceptable Standard of Service

A discussion of the institutional arrangements to handle the situation of system failure naturally leads to the issue of system reliability and quality of service. The customary supply of services -- e.g., central plant generation of electricity and distribution to users through a network for transmission lines -- provides high quality service of known reliability. Where this level of services does not exist, alternative supply systems will be obvious candidates for inclusion in new developments.* In most instances the existing central utilities system will provide a standard of service that alternative systems must approach to be viable candidates. Although reliability data for some innovative systems might be less than desirable, it can be assumed that installed systems will have met the developer's and the owner's expectations for reliability. Generally, however, the reliability possible in the installed system can be achieved only if a relatively complex set of operating procedures is closely observed. The reliability of the system, therefore, cannot be divorced from the capability of the operating staff to understand and to carry out correctly the additional responsibilities for system performance.¹⁴

A.7.4 Advantages of Automated Procedures

Many of the operating procedures could be incorporated into automated controls, reducing some of the dependence on specially trained personnel and perhaps achieving more consistent performance of the procedures.¹⁵ The operation of several total energy systems has been commonly controlled from a single automated control center.¹⁶ Complex schedules for providing building services and specialized service provisions for functionally distinct portions of the development also could be more easily accomplished with automated system controls.

Automated controls might also improve maintenance effectiveness. One way that reliability can be built into the system is through redundancy of major system components. Equipment maintenance schedules are set to reduce the

*One alternative is to choose another site where adequate services are available. For remote installations, however, this alternative might not exist.

probability of having a critical number of units out of service simultaneously. Rather than relying solely on component reliability statistics to project system reliability and plan maintenance schedules, the system operator could add component performance monitors to the automated capability to warn of degraded performance that should be corrected outside the customary maintenance schedule. If major maintenance or replacement of a critical system component is necessary, application of the network planning techniques discussed in the section covering Construction can help to minimize the down time for the unit and thereby optimize the use of maintenance personnel.¹⁷

A.7.5 Consumer Behavior and End-Use Energy

Finally, energy consumption of the development can be considered in terms of its use. Patterns of activity are built into the physical design of the development, the individual buildings, their uses, and their spatial relationships. A certain flexibility in types and schedules of use exists, however, and some unanticipated changes* could well occur within the lifetime of the development. It would be advantageous if the operating characteristics of the development's systems were similarly flexible to continue to provide energy-conserving services. In a more immediate sense, the effectiveness of energy-conserving planning for the development depends on how easily the end-use consumers can comply with the conservation intent within normal patterns of behavior. Variability exists in behavior and, therefore, in the way individuals will use identical units, as has been shown in studies of energy use in residential structures.¹⁸ A modest educational effort could heighten consumer sensitivity to the energy-conserving objectives of the design and increase the likelihood that use will be compatible with the objectives. In the end, a pragmatic, overall measure of design success will be the simultaneous fulfilling of these energy objectives, financial objectives, and other goals that have guided the entire development process.

*Changes could even occur before the project is completed, particularly if it is built over a long time by several developers.

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APPENDIX E

INSTITUTIONAL FACTORS AFFECTING ACCEPTANCE OF COMMUNITY
ENERGY SYSTEMS AND ENERGY-EFFICIENT COMMUNITY DESIGN:
PUBLIC PLANNING ADMINISTRATION, AND REGULATION

The material for Appendix B has been excerpted from an American Society of Planning Officials report of the same title, dated September, 1976.

B.1 INTRODUCTION

Growing awareness of the long-term nature of our energy problems continually stimulates new ideas for improving energy efficiency. The concept of integrated community energy systems (ICES) is one such idea currently under study by the Energy Research and Development Administration (ERDA). The ICES concept combines new energy supply technologies with utility services and waste recovery systems into integrated units. Designed to be at least partially self-sustaining and to operate at the community level, ICES may offer improved efficiencies in energy production, distribution, and consumption over traditional centralized power plants with their massive grid distribution systems.

But the road from conceptualization to commercial success for such new ideas can be long and difficult, and many good ideas have been detoured along the way. Not only must new energy technologies be commercially viable, they must also find favor with many public and private institutions--each with its own narrowly defined set of interests to serve--all of which will be involved in various aspects of design and development along the way.

As a part of ERDA's commercialization program, the purpose of this Appendix is to examine the potential response of public institutions to see how developers of ICES can expect to be received by public institutions in the fields of public planning, administration, and regulation.

• How will planners respond to technological innovations, such as community energy systems, located on-site and designed to serve units as small as a single subdivision or shopping center?

• How will other public administrators, planning commissioners, and legislators respond to such innovations?

- How will they react to related community design concepts for conserving energy such as a greater mixing of land uses than is now common, reduced street widths, and tighter clustering with higher densities?

- How compatible are these new energy technologies and community design concepts with the existing body of local and state law which governs community land development?

This appendix provides some tentative insights into the answers to these questions. It identifies key factors that may influence the public institutional acceptance of ICES and related energy-efficient design concepts, and suggests areas needing further study.

In addressing these questions, a range of energy-efficient design options for projects containing ICES is outlined. The related impacts of optimizing energy efficiency at the community level are considered because, in reality, goals of energy efficiency will have to be compromised to some extent with other community goals and objectives in such areas as environmental quality and housing equity. Following the results of a previous ASPO survey of energy conservation activities in planning agencies, a discussion is given of the relatively brief experience agencies have had with implementing various energy-efficient design options to date, and the implications for ICES. Finally, the manner in which public institutional factors are likely to constitute barriers to the implementation of ICES and related design concepts is considered.

B.1.1 Assumptions

Several basic assumptions have been made to guide this inquiry. First, since we are concerned here with the public sector's response to energy innovations, we have assumed the initiative for ICES and related design innovations will come from the private sector. Public institutions in this case are reacting to developers' proposals rather than seeking ways to encourage innovation themselves. Second, we have assumed that the price of energy has made these new concepts commercially feasible, at least to the degree of being attractive alternatives to conventional technologies. Third, we have assumed: (1) that any major technical problems with ICES have been resolved; and (2) that such systems are cost-competitive with alternative systems and operable at a level that satisfies basic consumer demands for clean, safe, and reliable energy production.

The goals of Integrated Community Energy Systems, set forth by ERDA's Advanced Technology-Mix Energy Systems (ATMES) research program are as follows:

1. Minimization of energy usage, especially where derived from oil and natural gas.
2. Minimization of energy system costs (initial, operating and/or life cycle).
3. Maximization of system reliability.
4. Development of inherently safe systems.
5. Development of systems that match the needs of communities.
6. Compatibility with national environmental quality goals.

Acceptance of the Community Energy System *concept* should be relatively widespread among public institutions, assuming that these systems achieve their goals as outlined in the previously stated assumptions (and barring any unforeseen negative impacts which might surface as designs for these new technologies become more specific).

Specifically, the planning community should have no trouble endorsing such innovative concepts. Energy efficiency is now a public policy objective in several community master plans. Planners have been promoting many energy-efficient design concepts for years, usually for reasons other than energy conservation. Trends toward greater public acceptance of flexible development regulations like PUD and performance zoning should also facilitate implementation of ICES. Furthermore, existing growth management policies and environmental quality objectives, common in an increasing number of communities around the country, directly complement many of the elements of ICES and related design concepts.

In spite of these positive factors enhancing the success of ICES, the actual implementation of these technologies is likely to encounter a number of practical impediments. It is premature at this stage in commercialization research to predict whether any one or combination of these impediments would prevent the widespread acceptance and use of ICES. However, their potential for inhibiting the commercial success of ICES is real, and they deserve more specific attention as the design of ICES hardware progresses in the future.

B.2 ENERGY EFFICIENT COMMUNITY DESIGN

The ICES concept should focus, not only on the technical components of energy production, but also on the design elements of the community it will serve. Maximum energy efficiency should be an important project design criterion; building orientation, density, street layout, and the choice of land use mix have an effect on energy consumption. Conserving energy through efficient planning and site design will reduce the load requirements on ICES, improving their competitive advantages against other systems. There is little sense in maximizing the efficiencies of energy production systems while ignoring energy intensive and wasteful design elements in the communities being served. To the extent possible, community design should be approached from a holistic point of view, integrating energy systems into overall project designs which maximize efficiencies in energy production, distribution, *and* consumption.

This section describes several design options that can be used at the project level to conserve energy through more efficient site design and development practices.

B.2.1 Climatic Options

In the United States, nearly 21.6% of our national annual energy budget is spent heating and cooling residential buildings (18.9% on heating and 2.7% on cooling).² This is over 70% of all energy used in the residential sector: most of the fuel required is oil or natural gas, both of which are in short supply. Because of the large percentage of energy used in space conditioning, the potential for conservation in this area is great. Moreover, building design and construction can be improved to increase the efficiency of buildings, and site design, positioning of houses, and use of vegetation can be effective in modifying or using the effects of sun and wind on buildings. By taking advantage of sunlight and natural protection from cold winds, a house will require less heating fuel. In summer, shading and use of breezes reduce energy needed for air conditioning. Several options for modifying microclimate to reduce the space conditioning demands of buildings are discussed briefly below.

In our discussion of climatic options reference will be made to the four climatic regions of the United States. Figure B.1 shows the boundaries of the cool, temperate, hot-arid, and hot-humid regions of the country.¹

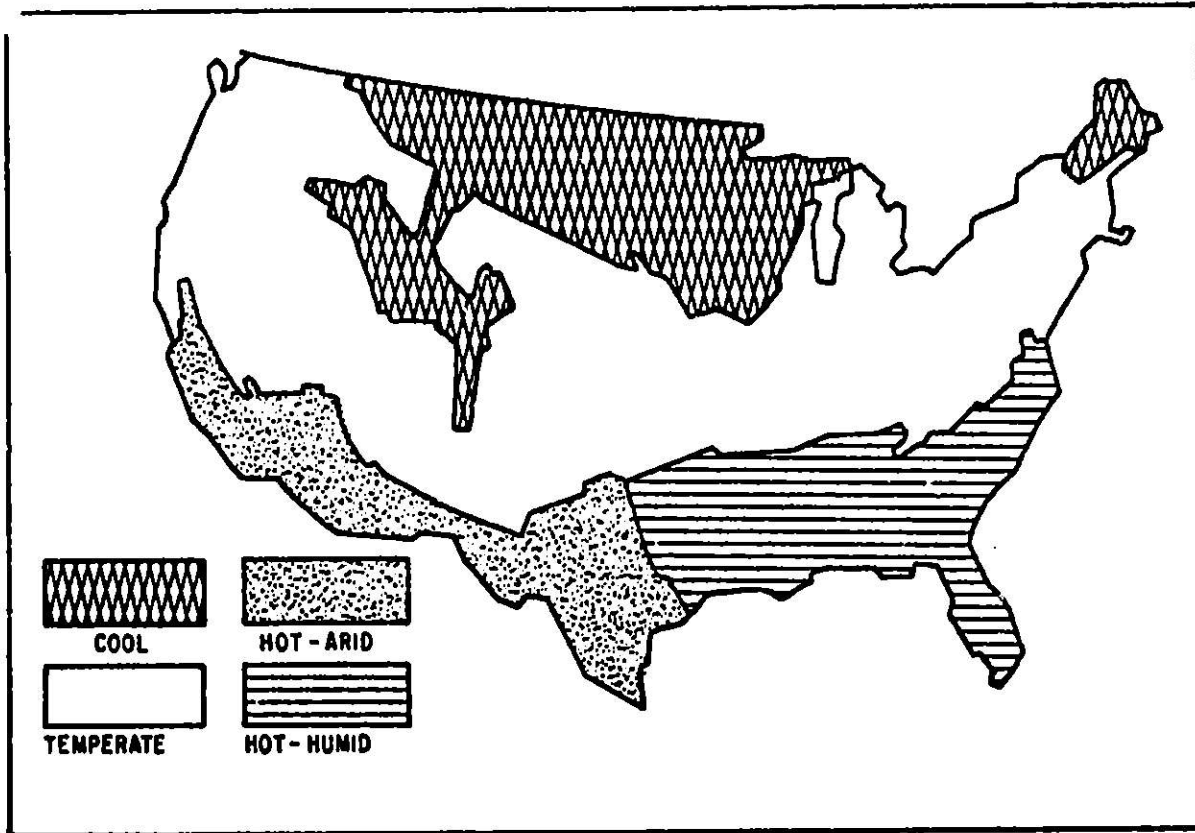


Fig. B.1 Regional Climate Zones of the U.S.

B.2.2 Topographic Siting

The physical site of a home, a commercial structure, or an entire development has associated with it a variety of characteristics: one is the mini or microclimate of a lot or a project site. The microclimate of a development site with its characteristics of wind, sunlight, and air drainage directly influences the amount of energy necessary to regulate the interior environment of any building in that location. If the site is particularly cold, more heating fuel would be needed. If a site is warm, more electricity for air conditioning would be required.

Many environmental factors determine microclimate; topography is one of the most important. As elevation, the angle of elevation, and the direction that a slope faces vary, so do the amount of sunlight, velocity of wind, and amount of cool air drainage received by the site. In most of the country a site that is topographically protected from winter winds, oriented towards the sun (i.e., primarily south), and located away from low "cold pockets"

is warmer in winter (see Figs. B.2, B.3, and B.4). In hot areas of the country, sites exposed to cooling breezes are most advantageous from an energy standpoint.

There are specific directional considerations in choosing the optimum orientation for saving energy used in space conditioning, depending upon the climatic region of the country.

In the cool zone of the country, siting for maximum warmth requires avoiding winter winds and locating in areas of maximum winter sunlight. A site that faces slightly east of south is most advantageous³ (see Fig. B.5). In this way a building is protected from prevailing northwest winter winds and receives maximum winter sunlight. In addition, siting in the middle portion of a slope, away from the windy crest or valley "cold pockets" offers increased warmth.⁴

In the temperate zone where hot and cold periods are more evenly balanced, siting requirements are broader in order to correlate the needs of hot and cold periods of the year. Advantageous site orientation is even further east of south than in the cool region. The upper and lower portions of a slope can be used more readily; the upper portion provided there is wind protection in winter and the lower portion because the cold pocket problem is not so crucial in the temperate climate.⁵

In the hot-arid region, siting for coolness is the priority. An east southeast exposure helps to balance the large daily temperature range by heating the site when it is most needed--in the morning when temperatures are lowest and avoiding the hot sun of late afternoon. Siting low on a slope takes advantage of cool air flow during overheated periods.⁶

In the hot-humid region of the country, maximum use of breezes is most important. Siting high on a slope near the crest of a hill where wind velocities are highest is advantageous. South and north exposures provide for the least intense solar radiation; however, because shading can be accomplished by other means, using the breezes on an east or west facing slope will also provide maximum coolness and minimum energy use.

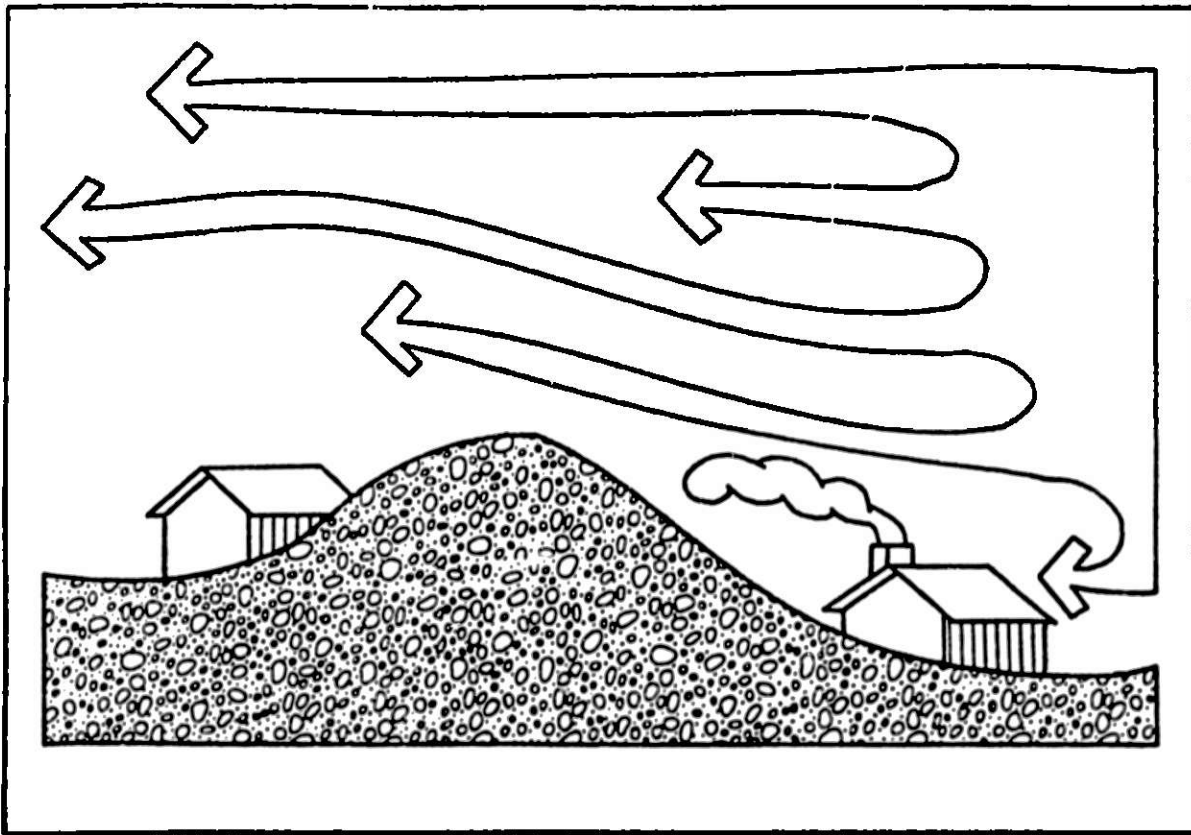


Fig. B.2. Topographic Siting for Protection from the Wind

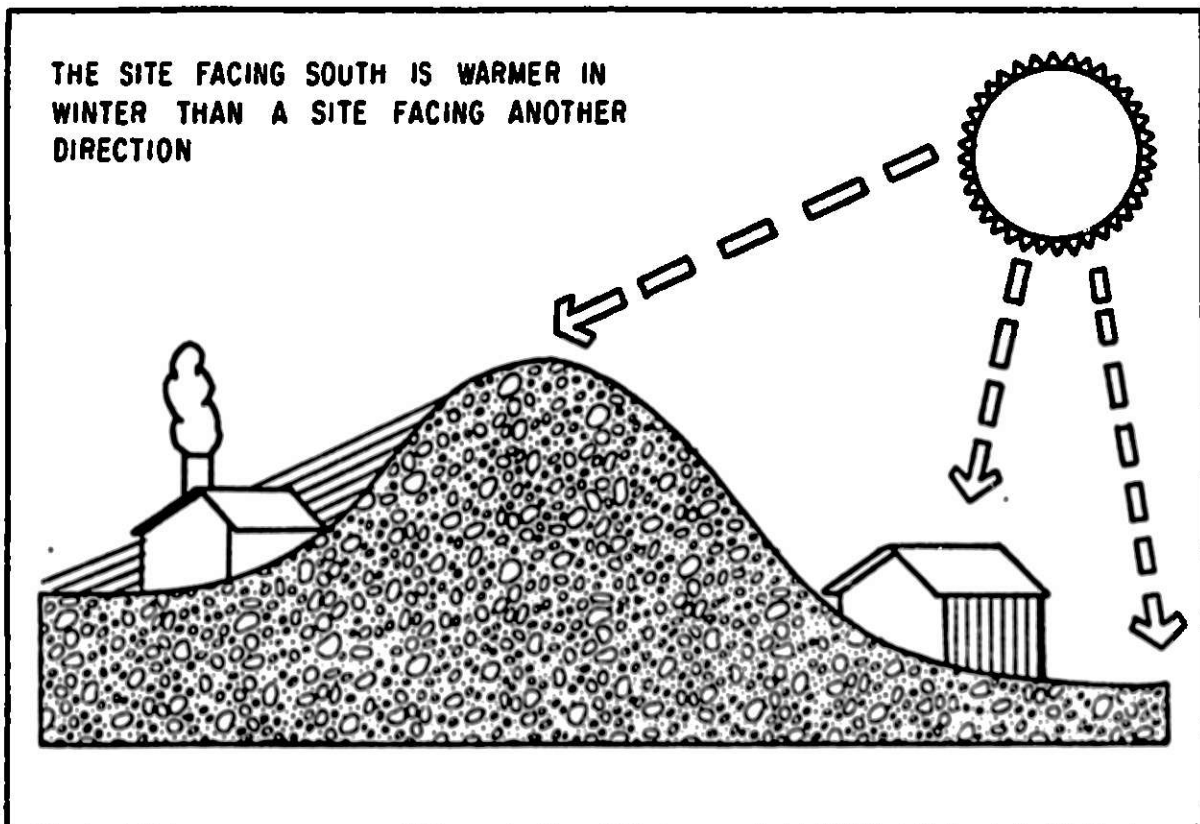


Fig. B.3. Site Orientation for Maximum Solar Heat

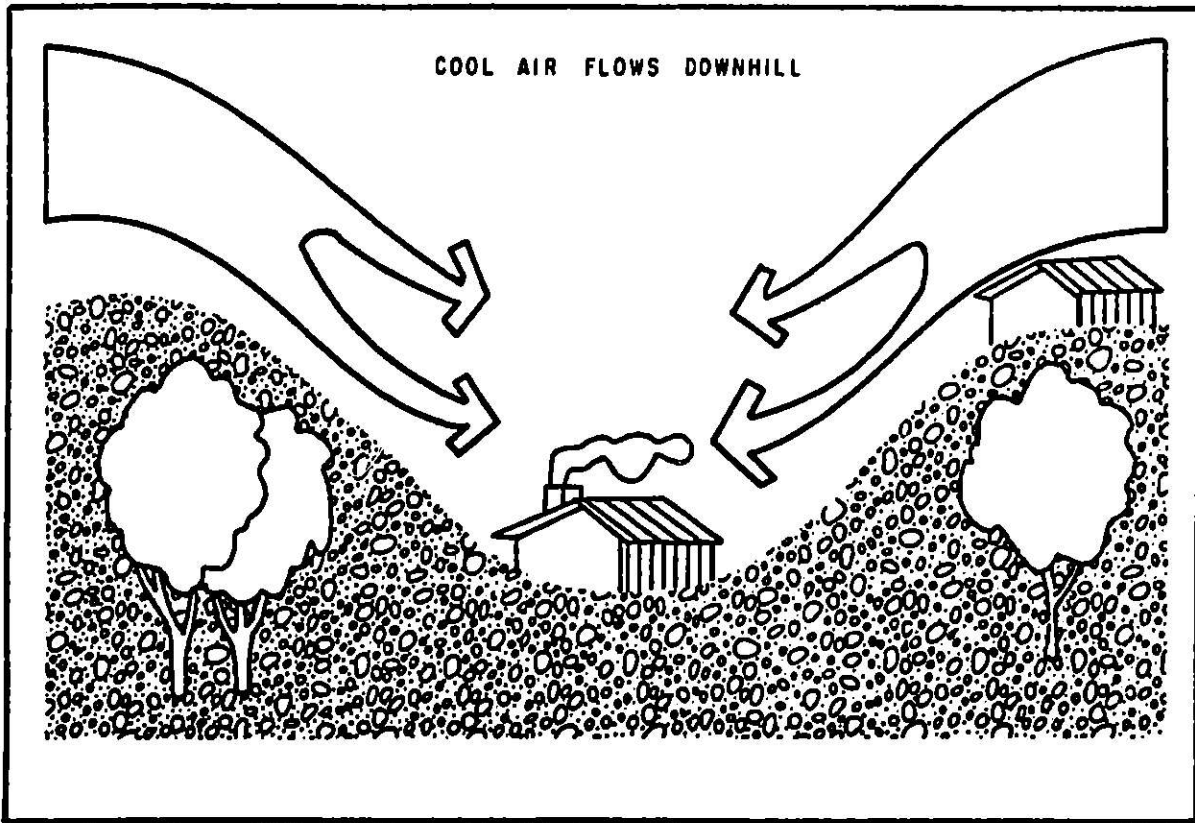


Fig. B.4. Cool Air Drainage and Cold Pockets

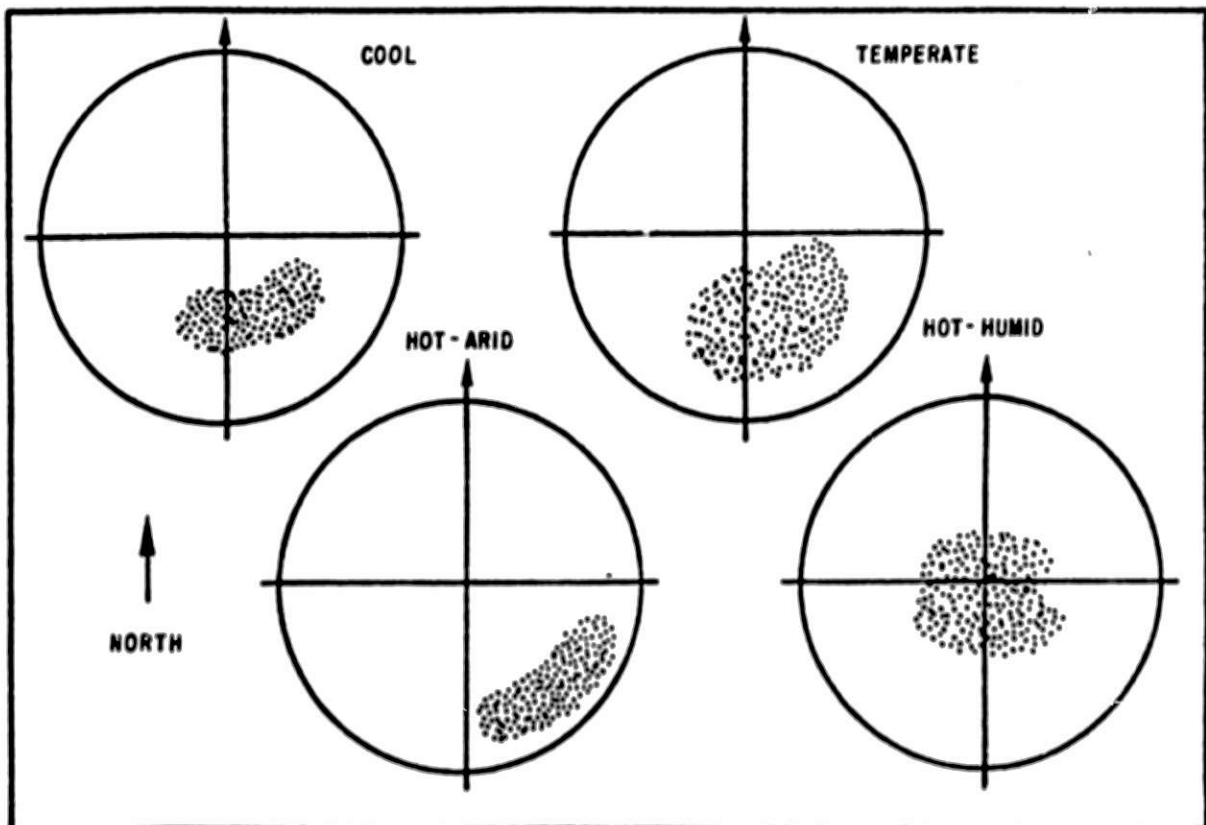


Fig. B.5. Desirable Site Locations in the four Climatic Zones

B.2.2 Building and Streets Orientation

In addition to topographic location, the orientation of a building on its site can help to utilize natural warmth and coolness and reduce space conditioning needs. Orienting the principal facade of a building toward the south means the greatest warmth in the winter and the greatest coolness in the summer. If the building faces east or west, maximum warmth will occur in summer and maximum coolness in winter, when both are least desirable. Optimum southern orientation varies somewhat depending on the climatic region of the country. Figure B.6 shows optimum directional orientation for the four regions.⁶

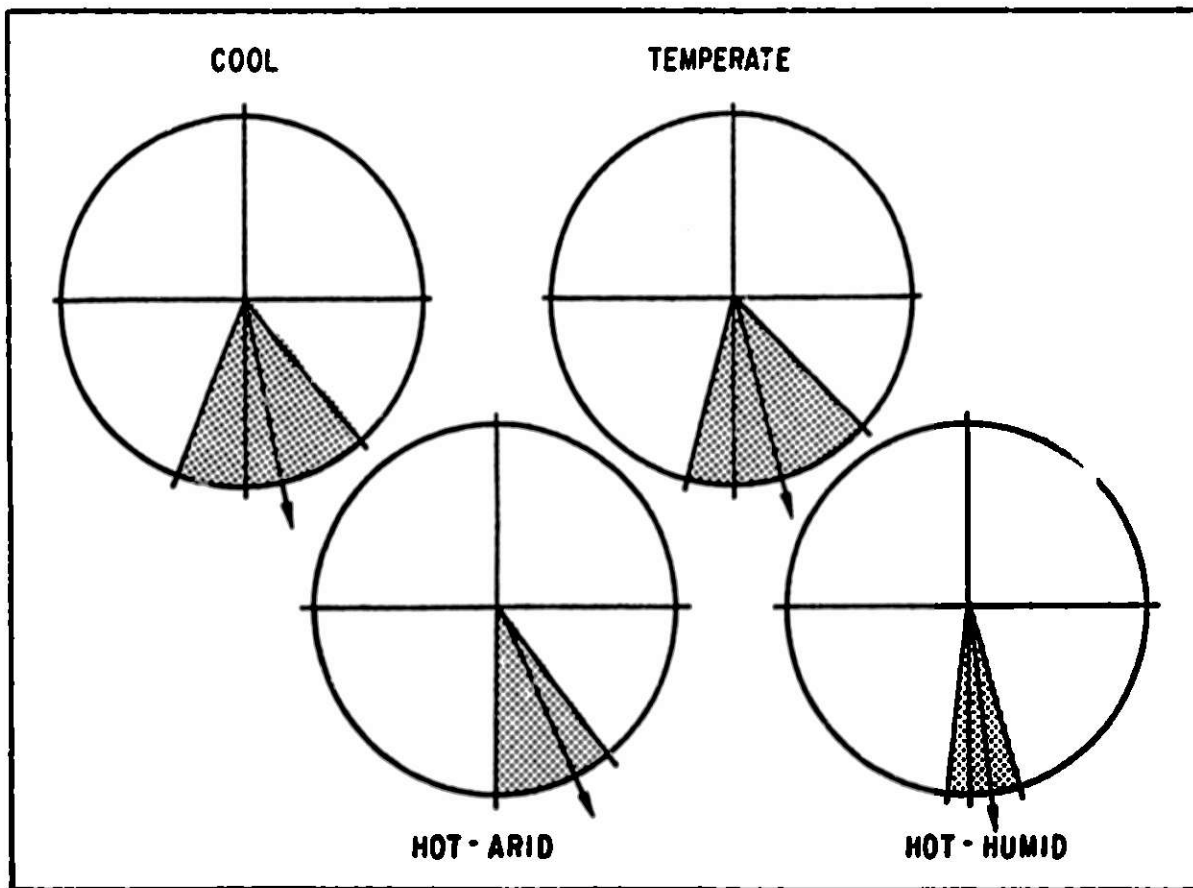


Fig. B.6. Desirable Building Orientation for Regional Climatic Zones

In residential buildings which have large windows and a high percentage of living areas in the front, southern orientation of the principal facade admits the maximum amount of solar energy in the winter to the most used rooms, which reduces the heating necessary to keep the indoor temperature of a house in the comfort zone. In summer the sun is higher in the sky and as shown in Fig. B.7, a house with a modest overhang will not admit any direct solar radiation from the south.

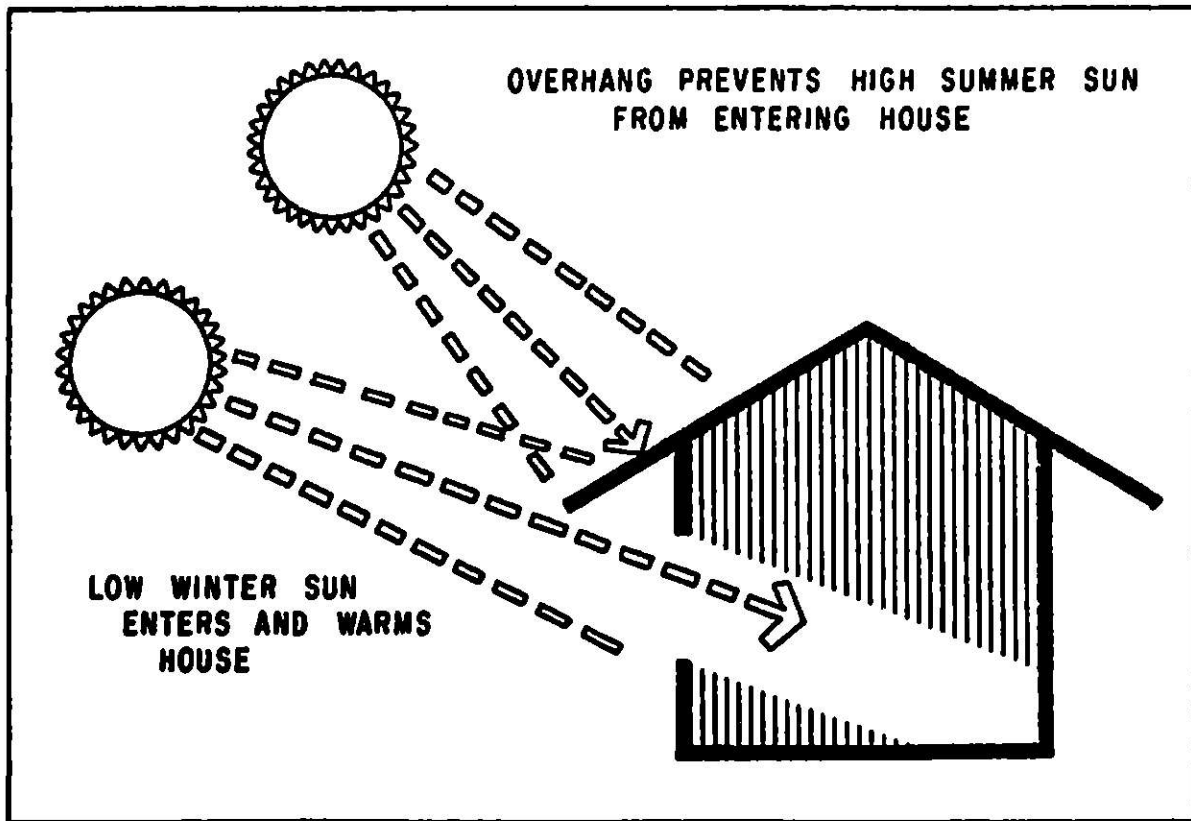


Fig. B.7. Summer and Winter Solar Angles

In the winter, at a 40 degree latitude, the south face of a building receives almost three times as much solar radiation as the east or west sides. In the summer the combined radiation on the north and south sides is half that received by the east and west faces.⁹ The south wall in summer actually receives about half the sun energy as it does in winter.¹⁰

Insofar as it affects housing orientation, the orientation of streets also can contribute to the energy efficiency of buildings. In many subdivisions

the houses face the street (i.e., the largest number of windows face the street or the back yard). If street orientation is primarily from east to west, either the front or the back of the homes will face south. The advantages of a southern orientation as discussed above will decrease the space conditioning energy demands of those houses. Other aspects of street design and layout that affect energy use will be discussed in later sections.

Energy savings resulting from southern orientation can be significant. A study of winter temperature response of unheated apartments in a complex in Davis, California showed that south-facing apartments had high temperatures in the 80s on sunny winter days with a maximum of 87°F. On several days the high temperature was 24° above the outdoor temperature and 17° above northeast and west facing apartments¹¹ (see Fig. B.8).

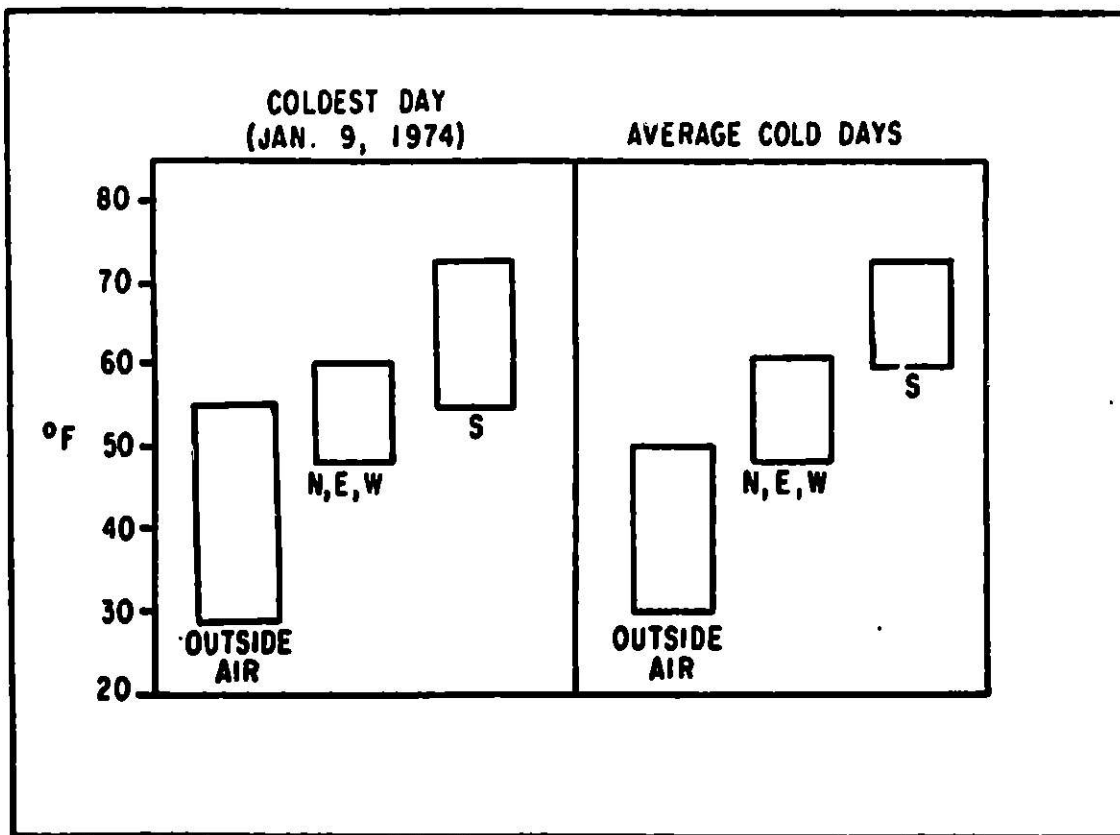


Fig. B.8. Winter Temperature Ranges of Unheated Apartments Facing Different Directions

In Manchester, New Hampshire it was estimated that by orienting the longitudinal axis of an office building from east to west (so the building faced south), nine and a half percent of the energy consumption for heating and cooling could be saved.¹² One homeowner/engineer who has included large south-facing windows in his home estimates that he has saved 63% in fuel over the years.¹³

B.2.4 Orientation and Clustering for Wind Protection and Breeze Utilization

In addition to the sun, winter winds and summer breezes have an influence on space-conditioning requirements. Buildings that are positioned perpendicular to the wind direction receive its full force; at 45° the velocity is reduced by 50%¹⁴ as shown in Fig. B.9.

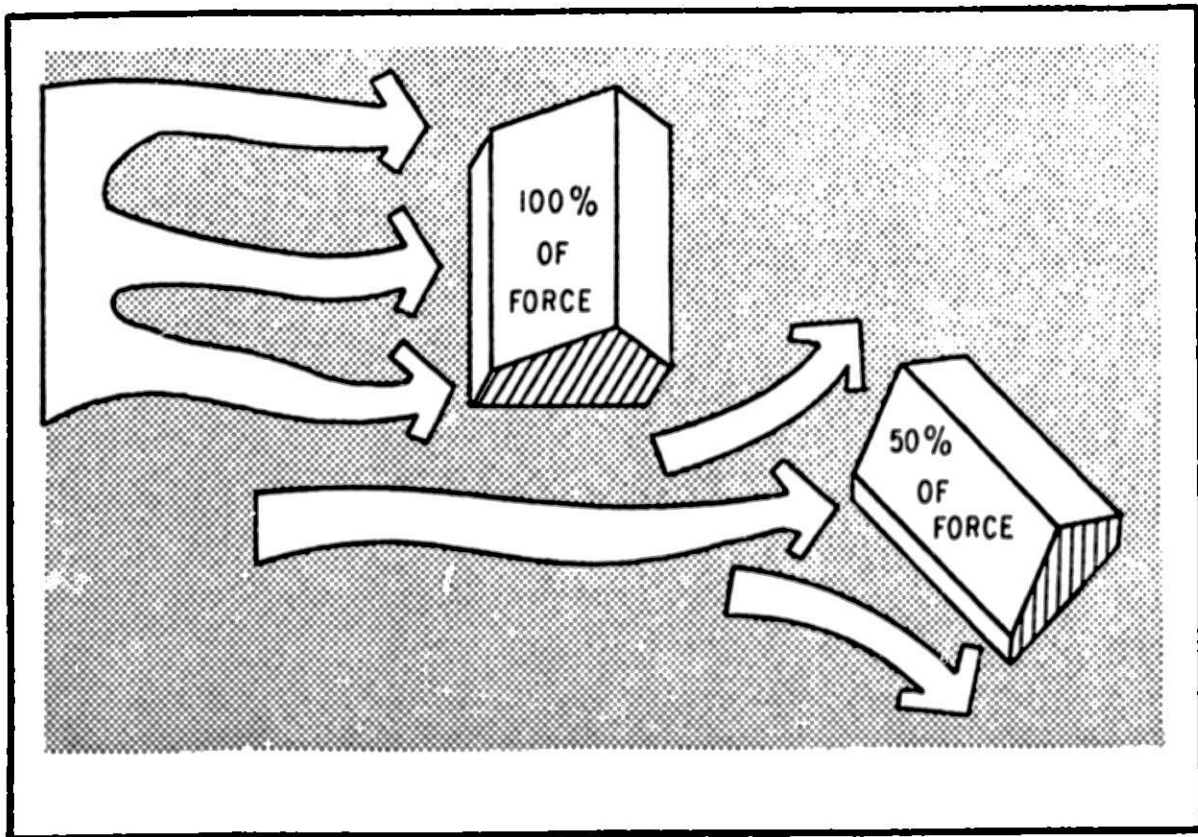


Fig. B.9. Building Position and the Effect of Wind

Houses arranged in a row protect each other from wind effects while staggered houses make use of the natural flow of the wind to receive optimum wind velocity. In winter the former arrangement is desirable; in summer the latter. Because winter winds and summer breezes usually come from different directions (e.g., in the midwest region prevailing winds are from the west in winter and southwest in summer), one pattern can provide optimum wind protection and breeze utilization.¹⁵ Sometimes optimum orientation for wind may be different than optimum orientation for solar utilization. In such cases the relative influences of wind and sun in space conditioning needs should be weighed to choose orientation.

Protecting a building through orientation to the wind itself, to the protection of other buildings, or to vegetation can significantly reduce energy needs. The heating load of an unprotected building in a 20 mile per hour wind is roughly 2.4 times greater than for the same building in a mile per hour wind under the same weather conditions.¹⁶

B.2.4.1 Using Vegetation to Modify Microclimate

Natural vegetation and landscaping can promote energy efficiency in a number of ways: 1) trees can provide shade to buildings from intense solar radiation in the summer and in hot regions of the country, reducing the need for air conditioning; 2) trees and shelter-belts can provide protection from cold winds and reduce heating requirements; and, 3) vegetation can provide shade, rain, and wind protection to pedestrians and bicyclists thus encouraging the use of these energy efficient modes of transport.

Trees have relatively high albedoes, that is, they reflect a good deal of the sunlight that falls on them back into the atmosphere. Table B.1 gives some comparative albedoes for trees and some typical urban surfaces.¹⁷ The low figures for black surfaces and concrete are due to the transformation of sunlight into heat rather than being reflected back into the atmosphere. Vegetation of any kind provides a much cooler environment than bare concrete or asphalt.

B.2.4.2 Trees for Building Shade and Outdoor Comfort

Shading a building from the outside is seven times more effective in keeping it cool than interior means of shading such as blinds or draperies.¹⁸

Table B.1. Comparative Albedoes

Surface	Albedo (%)
Deciduous tree crowns	18-20
Pine tree crowns	12-8
Black painted surface	0-8
New concrete	8-10
Old concrete	4-5

Vegetation, primarily trees, provides one of the best means of exterior shadings. Trees not only prevent direct solar radiation from falling on or entering a building, but they also tend to lower the air temperature of the surrounding environment. Thus, the temperature both inside and outside of the building is cooler. By strategically placing a few mature trees, a building can be shaded for most of the daytime hours. In winter when the sunlight is welcome, deciduous trees permit solar energy to reach buildings and the ground as shown in Fig. B.10.

The cooling effect of shade trees and other vegetation on the outdoor environment also contributes to energy conservation by encouraging walking and bicycling. Figure B.11 shows how a tree and vines on the side of a building can lower the air temperature above a sidewalk.¹⁹ Most people have experienced the effects of shade on sidewalks in the summer; protection from the sun is a significant incentive to using non-motorized transportation in hot weather.

Trees over a bicycle path or sidewalk can also provide protection from rainfall. One author has stated that:

. . . a canopy of coniferous and deciduous trees over a bikeway can reduce the amount of rainfall which reaches the bicyclist by as much as 20 and 40% respectively.²⁰

Raindrops are intercepted by the leaves and needles, flow down their stems to the trunk and to the ground at the base of the tree; the area under the canopy is kept much drier. In addition to providing protection from the elements to pedestrians and bicyclists, trees and other vegetation also encourage use of those energy-conserving transportation modes by improving the aesthetic quality of the outdoor environment.

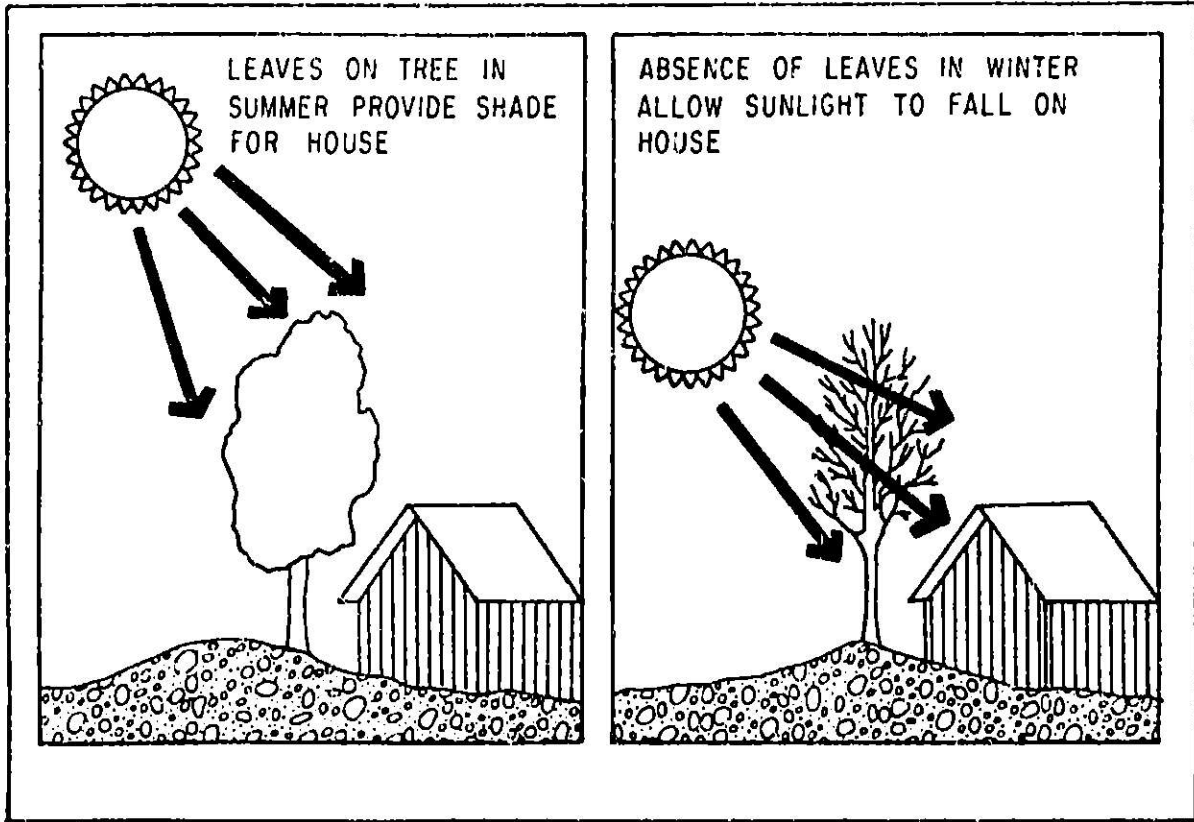


Fig. B.10. Microclimatic Effect of Deciduous Trees

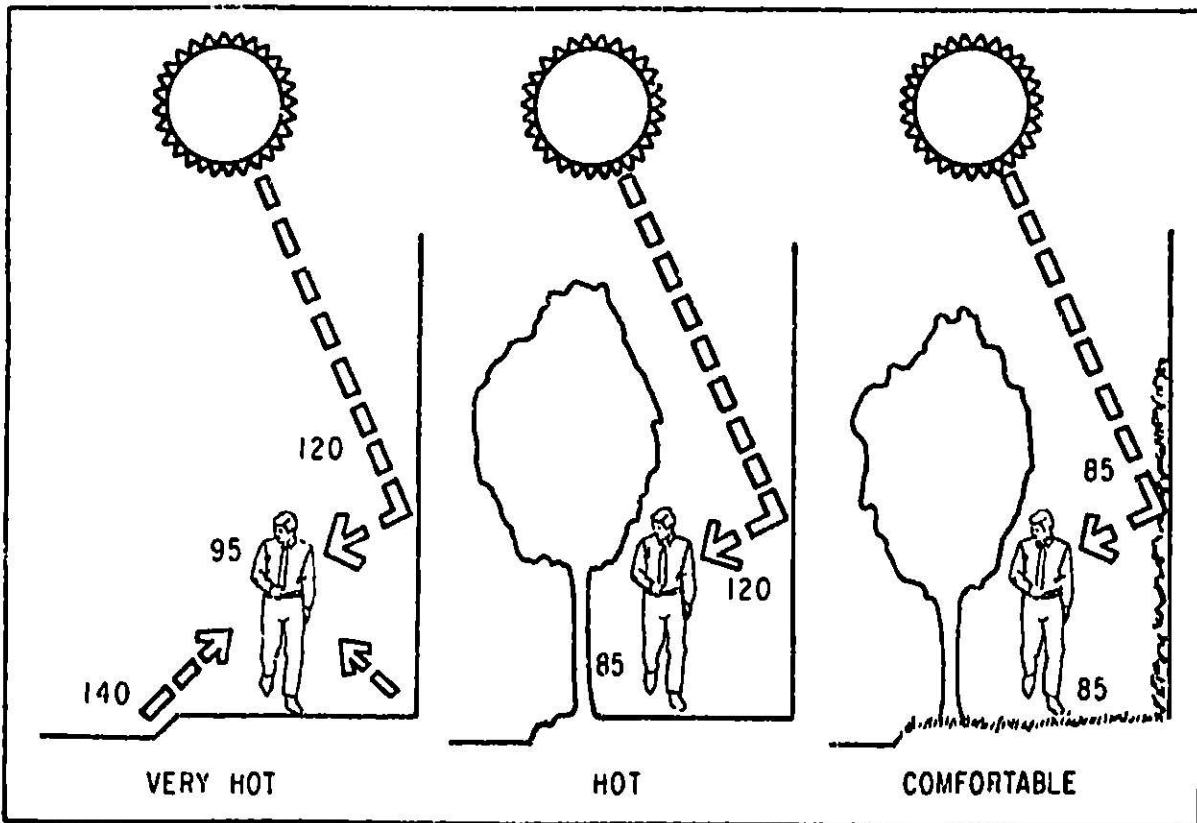


Fig. B.11. Effects of Vegetation on Air Temperature (90 Base Temperature)

B.2.4.3 Trees and Shelterbelts for Wind Protection and Breeze Utilization

Groups of trees or shelterbelts can provide protection from another climatic element--the wind. Especially in regions where high summer or winter winds are an environmental problem, shelterbelts can be highly successful in moderating their effects. Shelterbelts of deciduous trees can be used to provide protection from hot, dusty winds in summer, if protection from cold winter winds is required, evergreen trees must be used. The size of a shelterbelt depends on the size of the area that needs protection. A single home or an entire community could be served by a few trees or a shelterbelt a mile long, respectively.

Trees and other vegetation can also be used to optimize the cooling effects of summer breezes. Proper placement of a hedge or a line of trees can direct breezes into a building which would otherwise pass it by with less cooling effects of summer breezes. Figure B.12 illustrates this principle.²¹ Here a building which could not be oriented to take advantage of direct breezes can still take advantage of natural air conditioning.

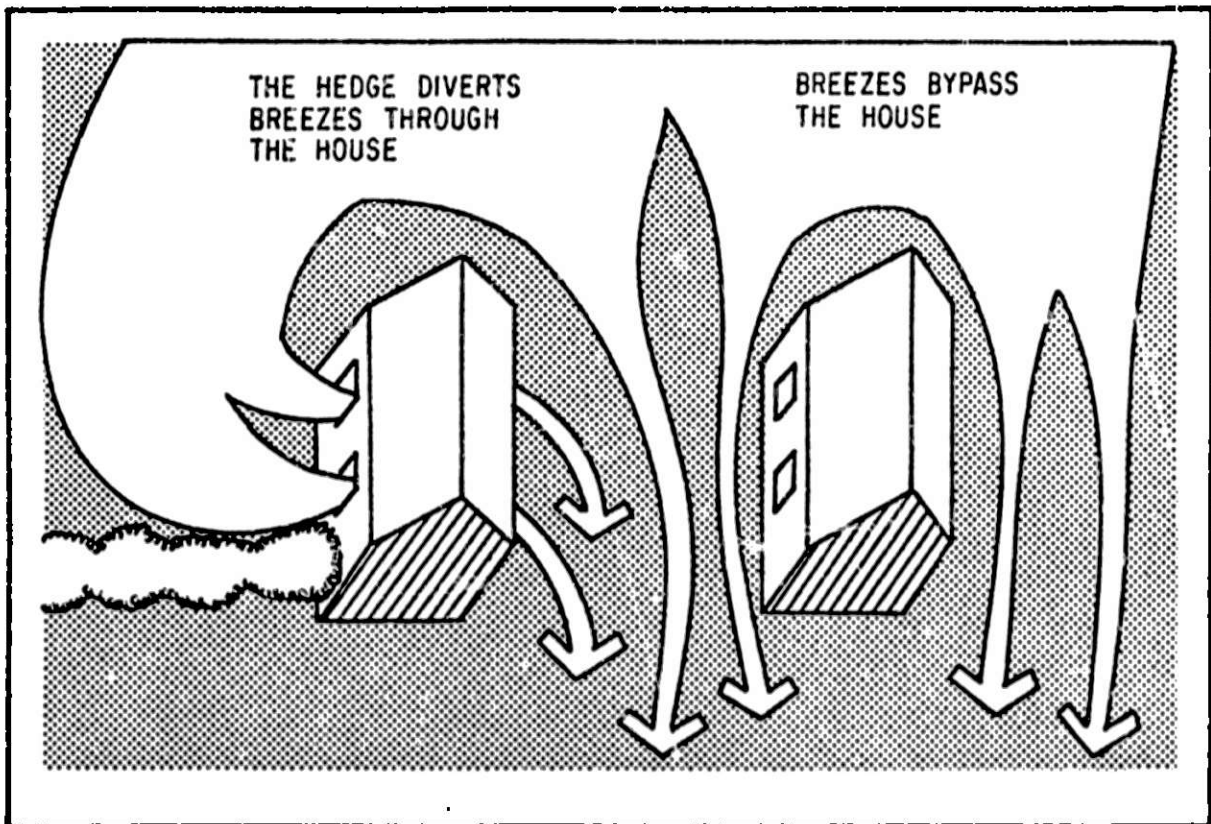


Fig. B.12. Effect of Vegetation on Breeze Utilization

Some of the energy payoffs from using trees for shade and wind protection have been documented. For example, it has been shown that a single tree eight inches in diameter when planted at an approximate cost of \$325, can provide enough shade to a medium-sized house to pay for itself in six years in terms of lower air conditioning costs during the summer.²² Several trees could provide even greater energy savings.

The increased comfort that trees provide for bicyclists and walkers saves energy too. Bicycling and walking are highly energy-efficient modes of transportation. One gallon of gasoline may provide 10 miles of travel and 417 miles on foot.²³ By providing the incentives of shade and wind protection to people who walk and ride bikes, non-renewable forms of energy used by cars will be conserved.

Energy savings from shelterbelts have also been calculated. In the experiments with wind and heating load discussed earlier, two identical test houses were maintained at 70°F, one protected on one side from the wind by a shelterbelt and the other left unprotected. The amount of fuel saved in the protected house was 22.9% of that used in the unprotected building. It was estimated that with good protection three sides of the house, energy savings could have run as high as 30%.²⁴

B2.5 Transportation Options

In 1970 transportation accounted for 25% of all of the energy consumed in the United States. Fifty-five percent of that energy is burned in cars, and 87% of what was burned in cars goes out the tail pipe as waste heat and exhaust.²⁵ To reduce transportation energy use requires more efficient autos and fewer vehicle miles travelled (VMT). The latter depends on reducing the frequency of use of automobiles and the distances of trips travelled. It is here that community design plays an important role. If automobile use for trips within a neighborhood or a subdivision can be made shorter and less frequent, significant savings in fuel consumption could be realized.

Discouraging automobile use and encouraging walking and bicycling within a subdivision can both be accomplished by a number of means. Built-in footpath and bicycle path systems with adequate protection from the elements will facilitate and encourage biking and walking. Clustering development can reduce

street length and the distance between residences and activity centers in a project. Clustering will be discussed in detail later on. Cul-de-sac streets inhibit through traffic and encourage people to walk or bike to destinations. Reducing street length and width saves initial construction materials and activity, and the energy needs associated with both. The reduction in asphalt and concrete surface areas also minimizes the rise in air temperature from sunlight absorption, thus, additional energy may be conserved through lower air-conditioning requirements.

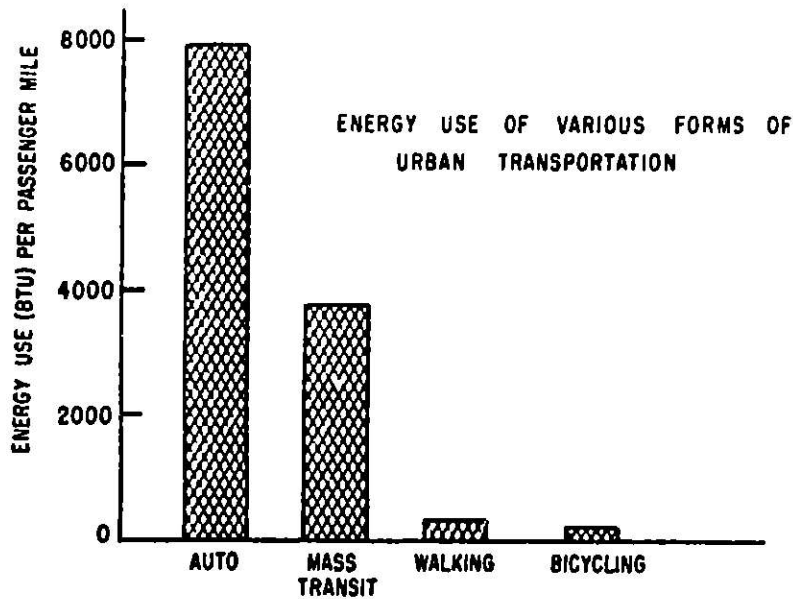
The circulation/transportation system in a project should be designed as a unified network from the outset. Streets, sidewalks, footpaths, bikeways, and public transit connections should be incorporated into the total plan from the start, rather than considering each element separately or as an after-thought. It may be difficult to use some of the innovations that will be discussed in this section unless they are built into the original land use concept at the beginning.

B.2.5.1 Bike and Footpath Systems

Bicyclists and pedestrians have several needs; the most direct route possible from one point to another, protection from winter winds and summer sun, and protection to the greatest extent possible from automobiles. Bike and footpath systems that are incorporated into the planning and design of subdivisions can most readily meet these needs. The neighborhood system can also be planned to complement existing systems that serve larger portions of the community. A study of motorists in Philadelphia found that 38% of those that owned bikes would commute by bike if safe bikeways and secure parking were available, and 17% that did not own bikes said that under those conditions they would buy them for commuting.²⁶

Energy-efficiencies of bicycling versus automobile travel are enormous. A bicycle travelling at 10 mph gets the equivalent of 1,000 miles per gallon of petroleum fuel.²⁷ Figure B.13 shows the comparative efficiency of bicycling and walking versus motorized transportation modes.²⁸

Because of this efficiency the U.S. Environmental Protection Agency has suggested that "increased use of bicycles in urban commuting could reduce auto vehicles miles travelled (VMT) by 2-3%."²⁹ The acceptable distance range for bicycle commuting is about four miles; if one-third to one-fourth of all of



SOURCE: ERIC HIRST, "TOTAL ENERGY DEMAND FOR AUTOMOBILES." SOCIETY OF AUTOMOBILE ENGINEERS, INC., p. 11, 1973.

Fig. B.13. Various Modes of Transportation Energy Use

those trips could be converted to bicycles, it is estimated that nearly one-half percent or 2.5 billion gallons of petroleum could be saved annually.³⁰ Foot-path and bicycle path systems offer real potential for energy conservation, not to mention the related benefits of lower traffic congestion and air pollution levels.

B.2.5.2 Reduced Street Width and Length

Excessively long and wide streets promote energy consumption in a number of ways: 1) extra energy is required for materials, construction, and maintenance; 2) extra impervious coverage may increase flooding that requires energy in flood control or damage repair; 3) extra coverage with concrete and asphalt tends to increase air temperature in the summer which places greater demand on air conditioning energy use; and, 4) wide streets encourage auto use and discourage bicycling. Research has indicated that bicyclist and pedestrian safety on streets increase as street width decreases, slowing traffic down.³¹

Traditional grid type subdivision and street layout produces maximum street length. This means maximum initial outlays of energy and materials to construct streets and necessitates longer trips by residents. A variety of circular design formats that often use cul-de-sacs can decrease street length considerably while serving the same number of dwelling units as a grid type layout.³² (See Fig. B.14).

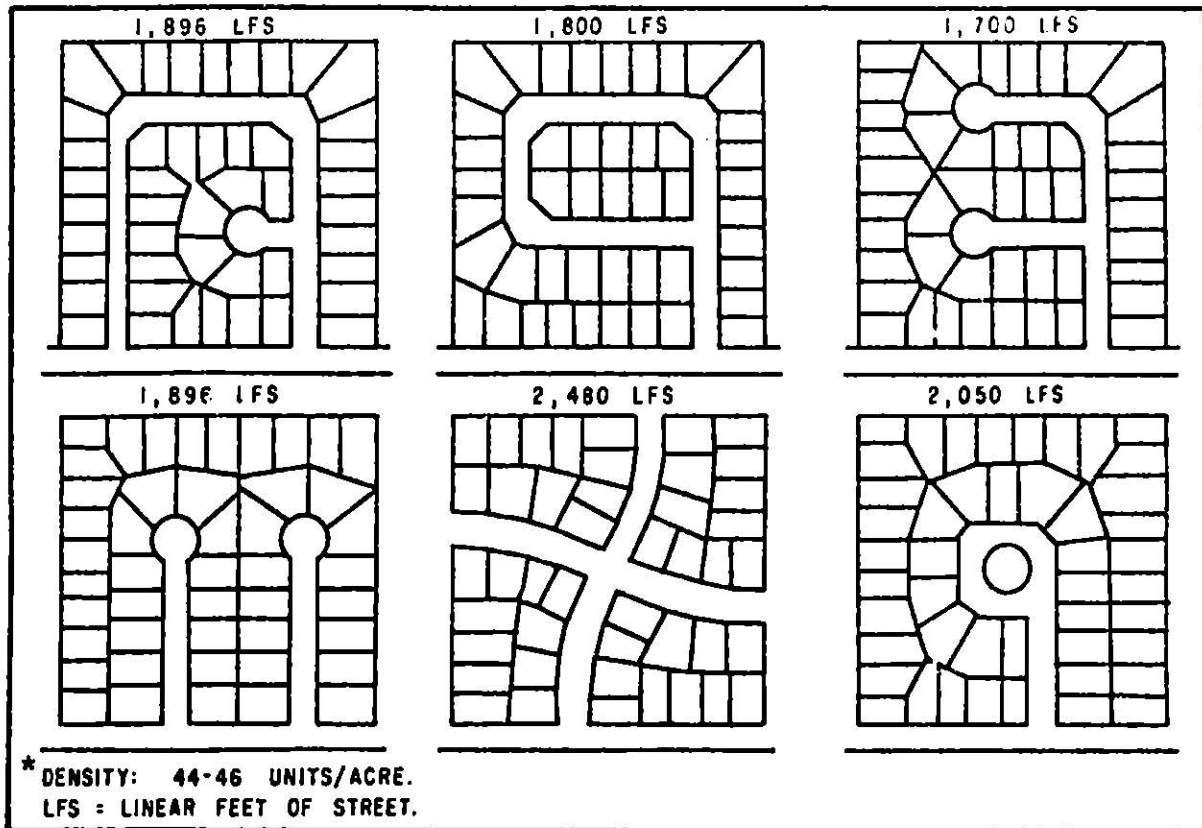


Fig. B.14. Street Design as it Effects Street Length with Density Constant*

In addition to considering length and width in street design, attention should be paid to the general compatibility of the new project streets with existing streets. If traffic is routed in the most direct fashion possible, to collector and arterial streets off-site, energy consumption will be minimized.

Width standards in subdivision regulations for a number of types of residential streets could be reduced without causing additional safety hazards. In Residential Streets, a joint publication of the Urban Land Institute, the National Association of Homebuilders, and the American Society of Civil Engineers it is noted that:

Residential Street pavement width practices largely have evolved from moving lane, parking lane, and design speed concepts. Width needs often were set to provide for the largest vehicle that might foreseeably use the street. Such design approaches are effective for the arterial street situation but are difficult to justify for residential streets serving small numbers of homes.³³

The report goes on to comment that while 36 ft is a common width throughout the country for collector and subcollector streets, width could be reduced to 26 ft

and still provide excellent performance. Widths for lightly used cul-de-sacs could be reduced to 18 ft or even 16 ft under certain conditions.³⁴

Reductions in the consumption of asphalt save energy. One barrel of crude oil when processed yields only 3% asphalt, and most streets are paved and repaved with asphalt. One author has suggested that a 50% reduction in length of residential streets to be built in the next 30 years could save 2.1 billion barrels of crude oil which is a half a billion barrels more than our annual import.³⁵

Reducing street surfaces also means dollar savings to developers and homeowners. A cost breakdown study on a proposed Davis, California subdivision showed that 57% of the lot cost was for site development including roads, lights, sewage and drainage systems, etc. If the street area of this subdivision could be reduced by 50% through narrower widths and reduced length, total site development costs would decline by almost \$700 per lot. In addition, the land taken out of streets could go into additional lots and the total savings per lot would be \$879 or approximately a \$7.83 savings per month to the home buyer on the mortgage payment.³⁶

B.2.6 Best Use of Mass Transportation

Development projects of any type--residential, commercial, or industrial--should be designed to facilitate maximum use of existing mass transportation systems. If bike or footpaths are included in a subdivision, a plan that links transit stops to residences via these paths will encourage use of mass transit. If a subdivision includes clustering or areas of varying densities, those areas with the highest density should be closest to existing bus stops or transit terminals as shown in Fig. B.15. Other heavy traffic generators, such as commercial facilities, should also be planned to take advantage of existing services. Such amenities as enclosed walkways, benches, and bike parking facilities near terminals will further encourage use of public transportation.

B.2.7 Housing Types and Density Options

The most predominant form of housing in this country--the single-family detached house-- is the least efficient user of energy, both in terms of space conditioning and transportation needs. A number of studies have pointed out that multi-family units tend to have smaller floor areas and suffer from less

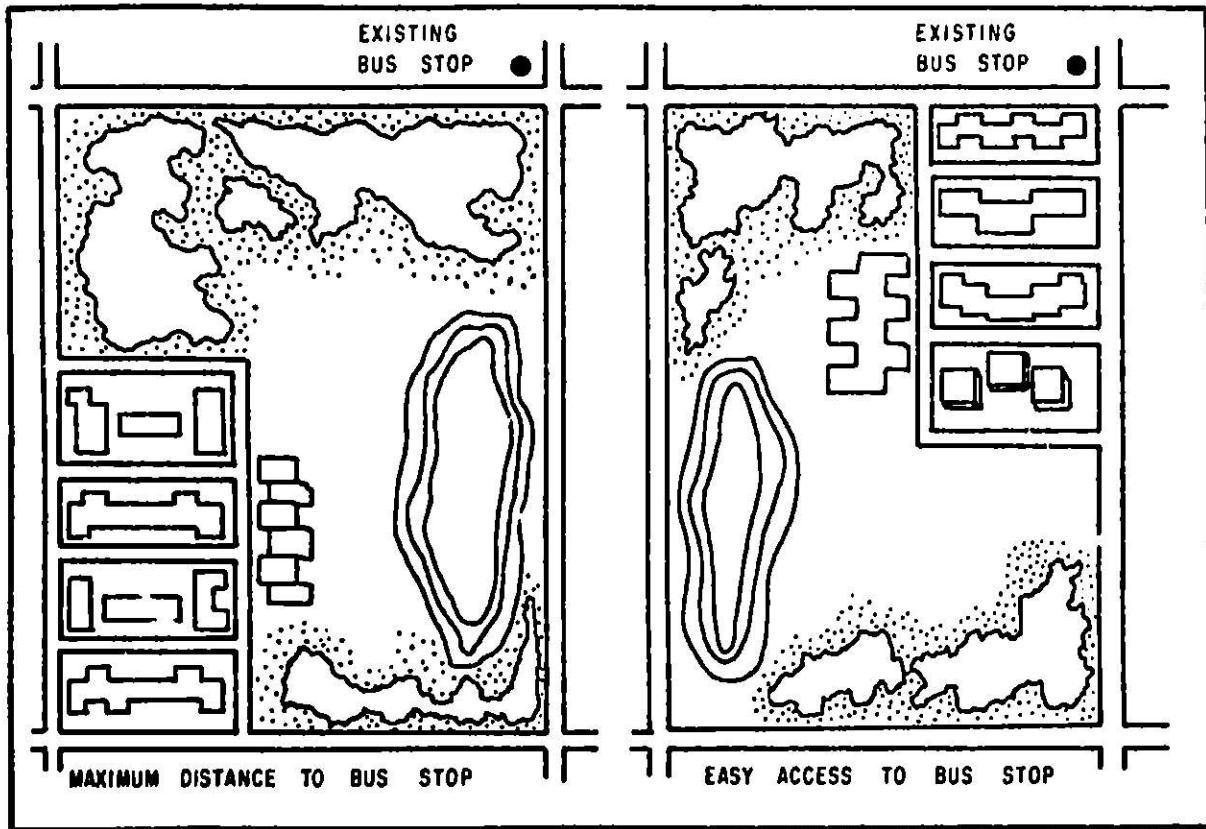


Fig. B.15. Design for Best Use of Mass Transportation

heat loss in winter and heat gain in summer, than do single-family units. Common wall construction creates less surface area per unit exposed to outside heat and cold. Cluster and higher density development can help to conserve energy through reducing space conditioning and driving needs. Clustering can also facilitate southern orientation of buildings for further savings in heating.

B.2.7.1 Options that Maintain Low Density

Clustering standard single-family detached units can save energy. With no increase in overall density, clustering of units in conjunction with innovative street design can reduce street lengths and automobile use. In Innovations vs. Traditions, the Urban Land Institute stated that by clustering at the same density (meaning reduced or pooled yard areas), street lengths could be reduced by 25%, while maintaining primarily single-family detached housing.³⁷ Figure B.16 shows how both innovative street design and clustering can produce shortened street lengths at no increase in overall density.³⁸

A more recent study by Real Estate Research Corporation confirmed this point and went a step further from the single-family detached model to a model using a mix of housing types but the same average density. This model was able to reduce overall street right-of-way lengths by 50%. The model had an average density overall of less than two dwelling units per acre.³⁹

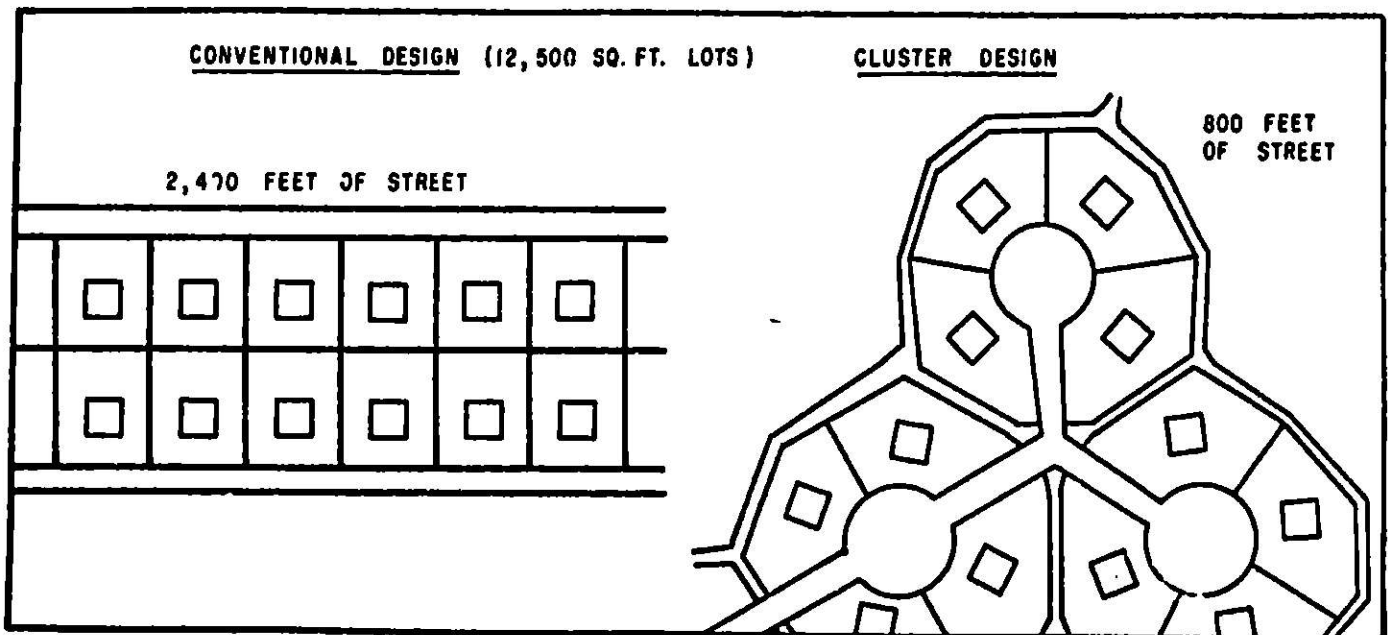


Fig. B.16. Clustering and Street Design

Planned development, using clustering and innovative street design, even at low densities yields significant savings of energy over conventional grid development. Increased energy efficiencies stem primarily from savings in materials and energy used in constructing streets. In addition, because streets are shorter, automobile trips within these projects are shorter and may be more likely to be travelled by foot or bicycle. Other savings can result from the reduction of street surfaces; summer temperatures may be somewhat lower because of the increased open space, requiring less air conditioning than developments with more street area. Through a flexible approach to site planning a developer can also do a better job of adapting a project to topographic and micro-climatic features; building orientation for solar utilization with its energy savings is also easier. The Costs of Sprawl estimates that the total energy savings from this type of planned development, even at low densities can reach between 8 and 14%.⁴⁰

Planned developments which include clustering may accommodate an ICES more readily as well. Flexible site designs in which dwelling units are clustered and open spaces pooled permit a more flexible approach to the siting of an ICES, and may help avoid use conflicts more likely in a conventional, tract subdivision.

B.2.7.2 High-Density Options

While energy efficiency in residential development can be increased through clustering and innovative design without increasing overall density or changing housing types drastically, increases in density through multi-family housing and apartment units offer much greater energy savings. Like clustered, detached single-family development, high-density development reduces street lengths. It also conserves energy in space conditioning, especially heating, since less wall surface is exposed to the outside environment. Higher density types of housing such as townhouses, and low- and high-rise apartments are both smaller and more efficient. A typical high-rise apartment unit is 42% smaller and uses 34% less energy per square foot than a single-family detached one-story house.⁴¹

High-density development also makes a variety of energy conserving options such as mass transportation, on-site shopping facilities, and recreational amenities more feasible--reducing the need to travel. Figure B.17 shows how three

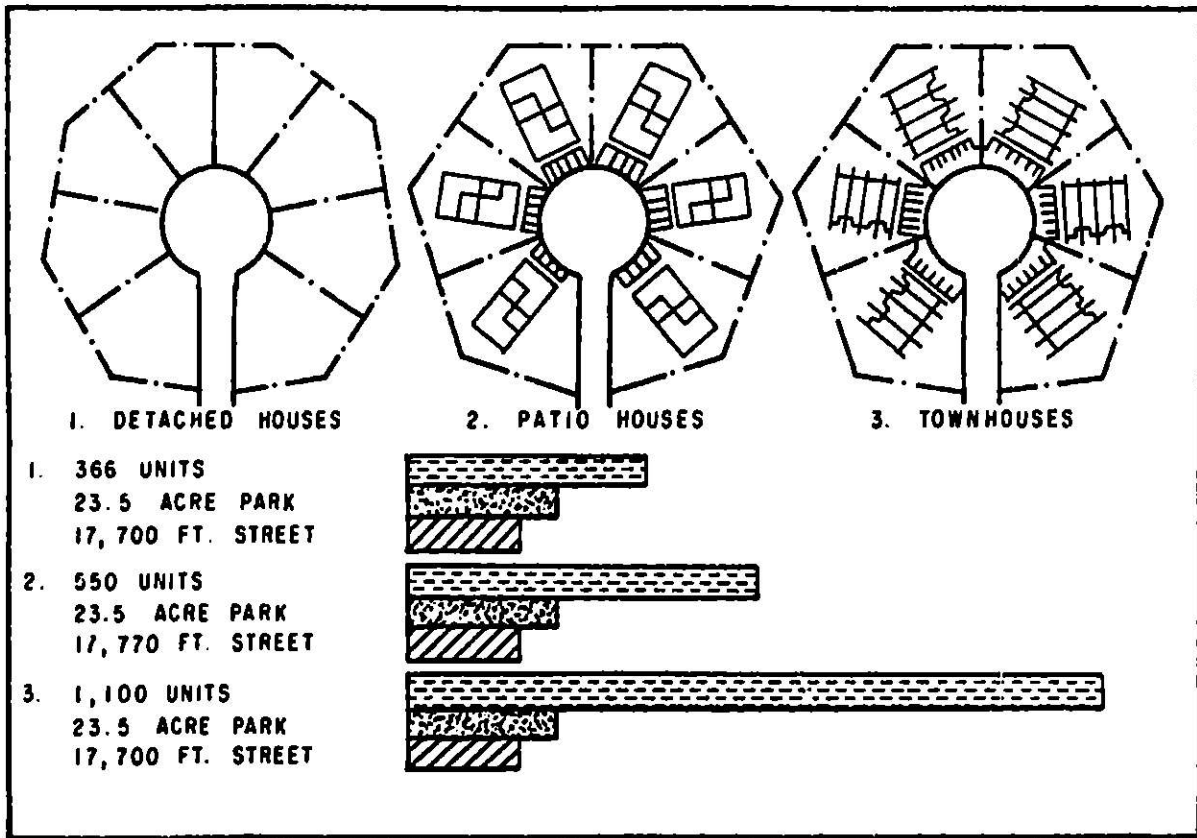


Fig. B.17. Density, Street Length, and Open Space

different types of housing density utilize the same length streets.⁴² Common wall housing also has the potential for use of centralized, heating and cooling systems which are more efficient than smaller, decentralized systems.

Table B.2 indicates the increased energy efficiency of high-density types of housing.⁴³ The Energy Intensity Factor is a measure of electrical and fossil fuel energy demand. Especially for heating, single-family detached housing is the least efficient, while high-rise apartment housing is most efficient. These

Table B.2 Energy Intensity Factors for Dwelling Units in the Northeast

Energy Intensity Factor	Single Family Detached	Attached	Low Rise	High Rise
Heat Demand	119	88	78	65
Water Demand	98	69	60	41
Cooking, Light, Refrigeration	11	11	11	11
Air Conditioning	3	2	2	2
Miscellaneous	7	6	5	5

figures are corroborated by The Costs of Sprawl which found that single-family housing used 156 therms of gas per month for space and water heating, cooking, and clothes drying, as compared with only 66 therms used in a high rise dwelling.⁴⁴ The report concludes that increased density and planning can reduce energy and water use by 40%.⁴⁵ It should be noted that these figures vary depending upon climatic region.

With regard to transportation energy use, the high-rise apartment at the upper end of the density scale requires much shorter streets than a single-family detached subdivision with the same number of units. For a 1,000-unit conventional subdivision 60,000 ft of road will be needed. A 1,000-unit high-rise complex requires only 8,950 ft, 86% less.⁴⁶ The high-rise complex will require somewhat wider streets for adequate traffic handling. Because most of the energy used in this country is used in the residential sector, planned and higher density development provide one of the most important means of conserving energy.

B.3 MIXED-USE DEVELOPMENT

Most communities seem to suffer from excessive separation of different land uses, a practice which promotes energy intensive land use patterns. While separating land uses is one of the underlying purposes of zoning, and a very important one, cheap energy and the automobile have encouraged land use segregation beyond that necessary to protect the health, safety, and general welfare of the public. Thus, it is common for suburban subdivisions to contain several hundred dwelling units and be miles from the nearest convenience food store.

Mixed use developments offer potential for creative combinations of different land uses within a single project such as including commercial office and recreational facilities in residential apartment complexes. Such integration of land uses would reduce the need to travel, plus offer opportunities for increased efficiencies in energy production via ICES and possible efficiencies in the use of waste heat and other resources. Economies of scale for ICES may be improved, as well as opportunities for siting energy facilities.

B.3.1 Convenience Shopping

Some of the most minor automobile trips made involve running errands to grocery stores for small purchases. Supermarkets are located generally within

commercial districts distant from residential neighborhoods. Smaller, convenience type grocery stores too, are often excluded from residential developments and require use of a car to reach. If small, convenience groceries were located nearer to residences, purchases small enough to hand carry could be transported on foot or on a bicycle. The Urban Land Institute has determined that a minimum population of 4,000 is necessary to support a "Neighborhood Center" which might contain between five and twenty stores.⁴⁷ Many subdivisions are not as large but could support a "Stop and Shop" type convenience store. If the store is incorporated into the planning of a project and, centrally located, it will serve the greatest number of residents with the greatest convenience. Such a facility could reduce the number and distance of auto trips necessary for minor purchases.

B.3.2 Office/Commercial Use

In addition to using an automobile for small grocery purchases residents must also drive to other commercial and professional establishments. Doctors' and dentists' offices, drugstores, beauty parlors, and other stores and offices usually are restricted to commercial or high-density residential/commercial development areas. Such uses, if carefully planned, could be compatible with primarily residential development. Depending upon density, some development projects could support a small or moderately sized store/office complex. Not only would it provide goods and services to residents within a short distance, but also would make some jobs available that could be filled by people who lived nearby. Thus, auto use for errands and for some workplace commuting could be cut.

B.3.3 Recreation Areas/Schools

Schools and playgrounds that are included in the planning of a development and can be located for easy access by children can contribute to the energy efficiency of the project. Especially when they are connected with pedestrian and bicycle circulation systems these facilities, as part of a development, will not require driving or busing kids to school or play. The practicality of a school as part of a development is dependent upon its size and density to a greater extent than for parks and play lots. Small play lots strategically located throughout a project are relatively practical; larger, improved facilities with

ball fields or picnic grounds could also be included.

B.3.4 Multiple-Use Buildings

Separation of uses has meant that many buildings are used for only one purpose, often during only part of the day or night. Heavy industrial buildings are used around the clock but commercial, recreational, and educational and social buildings often sit vacant for large amounts of time. These buildings although vacant must be heated, cooled and lighted to some extent. "Doubling up" of uses within one structure could save energy used in space conditioning and an additional amount of energy and materials that would otherwise be necessary in building two structures instead of one. Multiple use buildings have become relatively common in urban areas as large mixed-use shopping, office, and residential complexes are developed. At the subdivision scale there are fewer opportunities for multiple use buildings, but they exist. Developments that have planned both a sales office and activity center could combine the two within one structure. Separate areas within such a building would be required, but its energy efficiency would exceed that of two separate buildings. Other examples might include use of school recreational facilities for evening, adult use or use of a professional or office building for community meetings.

B.4 SUMMARY

Cheap and plentiful energy supplies in the past have permitted several decades of urban and suburban development to ignore the energy consequences of site design and land use decisions. Consumers, land developers, planners, and elected officials have not had to seriously consider energy consumption as a major criteria in development decisions in the past. But the opportunities for energy savings in project design are many. The design options discussed above are merely a cursory list of the most obvious examples. Incorporating such energy conserving design elements into overall project design should enhance the energy efficiency of ICES by reducing the energy needs of the intended users. Furthermore, a planned approach to total project design will facilitate the siting of ICES within development projects.

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B.5 EXTERNAL EFFECTS OF ICES AND ENERGY EFFICIENT COMMUNITY DESIGN

B.5.1 Introduction

Although energy-efficient design options and ICES appear to complement local growth management and fiscal objectives, the commercial success of ICES and related design option depends, in part, on the externalities or related impacts of these innovations. What effects will ICES have on environmental quality? What are their implications for growth management and fiscal policies of communities? Will they have positive or negative effects on employment and housing opportunities? Optimization of energy efficiency to the exclusion of all other community goals and objectives is neither likely nor desirable. Trade-offs will have to be made between the efficiencies of technical and community design innovations and other community goals and objectives, resulting in sub-optimal levels of energy efficiency. Regardless of the superior energy efficiency of new technologies, conflicts with other community goals could hinder and even prevent their public acceptance entirely. The experiences nuclear technology is having with environmentalists clearly demonstrates this point.

This section briefly examines four major areas of common public concern for complementary and conflicting objectives--growth management policies, fiscal policies, environmental quality, and employment and housing opportunities.

B.5.2 Growth Management Policies

Managing growth is a major public concern in an increasing number of communities throughout the country.¹ Strategies for managing urban growth have included controls over growth rates (such as through building permit procedures or various quota systems), controlling the provision of public investments in infrastructure (which in turn affects growth rates), and a variety of police power techniques designed to promote more compact development patterns, higher densities, and the infilling of vacant land parcels within urban areas.

The relationships between growth management policies and energy conservation are generally complementary. To the extent that growth management systems seek to contain urban sprawl and encourage denser land development patterns (without necessarily restricting population growth), they complement many of the objectives of energy-efficient community design options such as reducing the need to travel and facilitating economies of scale appropriate for ICES and

mass transportation. Reductions in public service costs due to growth management translate directly into energy savings for infrastructure construction and future operation, maintenance, and service delivery.

The goals of growth management and energy conservation, while broadly compatible, may, however, involve some conflicting implementation techniques. For example, some growth management systems rely on large minimum lot sizes in urban fringe communities as a means of encouraging dispersed, low-density development, which in turn may inhibit the commercial feasibility of ICES because of lack of sufficient economies of scale.

B.5.3 Fiscal Policies

The fiscal impacts of new developments are becoming increasingly important in public decision-making criteria. They are in some ways closely tied to growth management policies. Achieving positive fiscal impacts from a new development has been a common motivation behind many growth management systems. Fiscal policies are basically different, however, since they focus on the net fiscal effects of development on public treasuries, without necessarily implying any restrictions on amounts of growth. The goal of fiscal policy is basically to attract development which has positive fiscal effects on government (i.e., developments which generate revenues in excess of the costs of public services they consume).

Fiscal impacts of development are influenced both by types of development and by development patterns. Commercial and industrial forms of development have long had reputations for generally positive fiscal effects. Low density residential development, on the other hand, has been found to have negative fiscal consequences in many communities. Generally, leapfrog and sprawl patterns of development result in higher public service costs, and have less than optimal fiscal impacts. Both capital and public service costs have a tendency to decline with increases in density.²

To the extent that energy-efficient design options produce more compact forms of development through clustering or result in higher densities, they may complement the fiscal policies of local governments. Projects containing ICES are also likely to be fiscally attractive, although further study is required.

B.5.4 Environmental Quality

Many of the energy-efficient community design options discussed in Section 2 are compatible with environmental quality objectives. Flexible approaches to land development, such as PUD and clustering, permit greater sensitivity to the natural characteristics of the site.³ Reduced impervious surfaces due to reductions in street lengths and widths can reduce runoff and erosion from development sites both during and after construction. Controls over vegetation and landscaping can also help to retain runoff, as well as enhance other aspects of the environment.

On a broader scale, higher densities conserve resources, help to preserve open space, and reduce sprawl. At some point, however, higher densities may reach levels of diminishing and even negative returns by concentrating sources of air and water pollution.⁴

Both on-site and off-site environmental impacts of ICES are major unknowns at this point. Assuming they will include both energy production facilities and utility services, their potential for negative environmental impacts is relatively high, especially in residential developments.

B.5.5 Employment and Housing Opportunities

The primary and secondary economic impacts of ICES and energy-efficient community designs are an important consideration, and should be explored in depth when more precise design and cost characteristics of ICES become available. Effects on employment and housing opportunities will be especially important to public policy makers.

At this preliminary level of inquiry, there appear to be no reasons to suspect that more energy-efficient community designs or ICES would have any negative effects on employment opportunities. Few, if any, jobs are likely to be displaced. It is more likely that new jobs would be created in the design, manufacturing, and construction of energy systems. Net employment consequences, measured in terms both of numbers and job skills, should be part of any further analysis of these technologies.

Effects of design options and ICES on housing opportunities may be more serious. On the one hand, prospects for higher density communities are likely to hold down or reduce housing costs, thereby enhancing housing opportunities,

especially in the lower and middle income brackets. The Costs of Sprawl found that:

The cost of housing is least for walk-up apartments (5 units per gross acre), being only 37% of housing costs at a density of 2 units per gross acre. Housing costs at a density of 10 units per gross acre are somewhat higher than for walk-up apartments, but are still only 47% of the housing costs at 2 units per gross acre.

On the other hand, designing more energy-efficient communities will initially be more costly than ignoring energy considerations in design. Development costs of ICES may also be substantial. It is assumed that the new energy technologies will be cost competitive with conventional energy and utility systems--that lifecycle costs will be lower for developments served by ICES. But first costs, which remain very important to consumers, especially in lower income groups, may increase substantially unless financing arrangements can be made to keep them within acceptable levels of target income groups.

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B.6 IMPLEMENTING ICES AND ENERGY-EFFICIENT COMMUNITY DESIGNS

B.6.1 Introduction

An important factor in the commercial success of ICES is the ease with which these projects will be able to comply with local land development regulations. This compliance depends, in part, on the nature of the implementation tools and techniques used by government to control projects including ICES and related energy-efficient designs. Preliminary studies indicate that the costs of complying with the law can be a deciding factor in the economic success of development firms operating close to the margin.¹ Costs of compliance with regulations have risen substantially in recent years, and the sheer volume of public control over land development has increased. Regulations and administrative review procedures also have become more complex and have added to the costs. As a result, some land developers have chosen to avoid flexible regulatory concepts like planned unit development ordinances (PUD), in part because of the increased costs of complex public review procedures, which, in turn, increase the developers' carrying costs by lengthening lead times for project approvals, and by necessitating more sophisticated planning and management skills.

How will local governments control land developments containing ICES and related energy-efficient design concepts? Can existing regulatory techniques be used to implement new energy technologies and design options? Will new regulatory devices become necessary? No experience with ICES exists on which to base answers to these questions. However, several public institutions have had some limited experience with implementing energy-efficient design concepts and can provide some useful insights.

The 1973 energy crisis caused a brief flurry of activity among planning agencies and other administrative departments of local government. A few planning agencies took the first steps in examining how they might increase energy conservation in the private sector by influencing land-use decisions. ASPO* conducted a survey of local, regional, and state planning agency activities in energy conservation in 1975.² A few agencies had begun studies of energy consumption patterns and their relationships to land use and development. Others had adopted policies on energy conservation. Several actually adopted or amended legislation aimed at improving the energy-efficiency of land development practices.

*American Society of Planning Officials

B.6.2 Energy Planning Policies

As a result of the 1973 energy crisis, several communities, as well as several state governments, have undertaken energy studies. Some have resulted in the adoption of energy policies calling for conservation through land use and community design measures.

A background energy study done for general planning purposes is The Planning Document: Watonga, Oklahoma.³ This study and plan is unique in that it contains a major section on planning for microclimate modification. One section reviews the climate of Watonga and such climatic conditions as solar radiation and temperatures, precipitation and water loss, and winds and ventilation. It then goes on to consider principles of microclimate that could be used to modify climatic extremes. The study concludes by making a number of proposals for the provision of shelterbelts, the modification of structural characteristics of the central business district, and the alteration of the general urban form in a way that would significantly modify its climate.

An excellent example of a local study aimed specifically at the development of a strategy for energy conservation and the design of appropriate implementation tools, is one done for the City of Davis, California.⁴ The study first analyzes various aspects of how houses and neighborhoods in the city operate, how they consume energy, and how they could be made to consume less. It reviews the relevance of various types of building construction, building orientation, windows, insulation, vegetation, and roof overhangs to the conservation of energy and proposes measures to improve existing buildings and a set of building standards for new buildings. Finally, the study considers four categories of neighborhood planning suggestions aimed at the conservation of energy: (1) the development of the most efficient circulation system possible; (2) the efficient use of land; (3) the efficient use of the sun; and (4) landscaping for climate improvement.

Another study⁵ starts with an analysis of existing energy consumption patterns by source and end use and poses six alternative development scenarios: (1) wedges and corridors; (2) dense center; (3) transit oriented; (4) wedges and corridors with income balance; (5) sprawl; and (6) beltways. The report then estimates future energy consumption for each of the six scenarios. After discussing the influence of environmental, political, economic, and institutional factors on the location, character, and pace of development, the report concludes

with the translating of its earlier analyses and discussions into a series of policies and implementation strategies. This type of study is significant in that it is likely to promote greater public acceptance of the necessary life-style changes implied by the policies and implementation strategies.

B.6.2.1 State Energy Conservation Policies

A few states have also adopted energy policies affecting land use, which directly address planning and development at the local level through enabling legislation, and requiring local jurisdictions to include energy conservation elements in their general plans.

An example of state energy conservation policies based specifically on alternative land use design options, is the Energy Conservation Goals and Guidelines of the state of Oregon. The intent of these guidelines is to provide a basis for energy conservation at the local level. The goals and guidelines cover a wide range of planning issues that relate to energy conservation:

Goal: To Conserve energy

Land and uses developed on the land shall be managed and controlled as to maximize the conservation of all forms of energy, based upon sound economic principles.

Guidelines:

A. Planning

1. Priority consideration in land use planning should be given to methods of analysis and implementation measures that will assure achievement of maximum efficiency in energy utilization.
2. The allocation of land and uses permitted on the land should seek to minimize the depletion of non-renewable sources of energy.
3. Land use planning should, to the maximum extent possible, seek to recycle and re-use vacant land and these uses which are not energy-efficient.
4. Land use planning should, to the maximum extent possible, combine increasing density gradients along high capacity transportation corridors to achieve greater energy efficiency.
5. Plans directed toward energy conservation within the planning area should consider as a major determinant the existing and potential capacity of the renewable energy sources to yield

useful energy output. Renewable energy sources include water, sunshine, wind, geothermal heat and municipal, forest and farm waste. Whenever possible, land conservation and development actions provided for under such plans should utilize renewable energy sources.

B. Implementation

1. Land use plans should be based on utilization of the following techniques and implementation devices which can have a material impact on energy efficiency:
 - (a) lot size, dimension and siting controls;
 - (b) building height, bulk and surface area;
 - (c) density of uses, particularly those which relate to housing densities;
 - (d) availability of light, wind, and air;
 - (e) compatibility of and competition between competing land use activities; and,
 - (f) systems and incentives for the collection, reuse and recycling of metallic and nonmetallic waste.⁵

These guidelines became operative in January, 1976. Although they are not mandatory, the state can require that suitable guidelines be substituted.

Other means through which states can promote the conservation of energy include: (1) enabling or requiring local jurisdictions to include an energy element in their comprehensive plans, (2) requiring that local zoning and subdivision documents include energy-conserving measures in conformance with the energy elements of their comprehensive plan, and (3) promoting energy conservation measures in the development of lands directly controlled by the state.⁷

Several states recently have taken the approach of exercising more direct control over land development in critical areas. Included are Florida, Nevada, and Oregon. However, none has included energy conservation as one of the objectives of such control. Including energy conservation as a goal in the control of critical areas, would allow states to direct development into energy-efficient locations and to establish energy-efficient standards for such development.⁸

B.6.3 Master Plans

Local Master Plans, General Plans, and Policy Plans have been used as guides to implement zoning and subdivision regulations. To effect an energy conservation policy and its consequent community design options via these land use controls, a thorough formulation of land use related goals and policies

is necessary. Over the past three years, more and more local jurisdictions have included such goals and policies in their general, master, or policy plans to provide the jurisdiction with an official guide that will serve public officials and citizens in energy-related decision making. Energy elements used so far range from a very general statement of energy conservation goals to a very specific delineation of energy-efficient land use policies: the effectiveness of these policies as guides to implementation varies with the level of policy detail. For example, very general energy policy was adopted by the Evanston Plans Commission in 1974 to encourage and effect use of energy in all its critical forms by public and private users alike.⁹

Eugene, Oregon also has adopted a set of energy-related planning policies.¹⁰ This approach, however, differs from the previous one in that it translates the general policies into several land use proposals. One proposal gives recognition to the need that zoning and land use decision making will have to be examined in relation to energy consequences. Although not referring to any energy-efficient design options yet, this proposal demonstrates concern for the issue and gives consideration to appropriate means of implementation.

An energy policy proposed by the Albuquerque/Bernalillo County Planning Commissions, gives land use design factors a prominent place among other energy conservation policies. Its energy-related land use policy simply states that "The City and County shall pursue land use planning that will maximize potential for energy conservation." One technique proposes the implementation of the land use policy through the encouragement of planned unit developments and clustered housing "to enable replacement of individual systems with a single or cascaded community energy system."¹¹ Another technique is to encourage, through planned unit development, variety in housing design and orientation similar to one of the design options proposed earlier. The other techniques bear further similarity to the design options in Sect. 2. They include encouragement of natural vegetation that will maximize shading in the summer and sun penetration in the winter and increased densities in selected areas. This policy statement goes further to propose tools of implementation: zoning, detailed land use plans, and the use of the planned unit development approach.

A stronger commitment to land use options and techniques aimed at the conservation of energy has recently been made by the City of Lincoln and Lancaster County, Nebraska. Early in 1976 both the city and the county

adopted an energy policy statement^{12,13} that is significant in a number of ways: (1) it recognizes land use design as a major factor in energy conservation; (2) it encompasses many of the known design options; and (3) it makes a clear commitment to those options by adopting them as policy.

The policy statement guidelines are quite specific in that they detail a number of design options and implementation strategies for energy conservation.

These background studies and policy statements represent important first steps for increasing the energy consciousness among public institutions, especially with regard to land development. Few of them, however, have achieved any measurable success due to lack of follow up with implementation programs. Results of telephone interviews with local and state officials indicated that the energy consciousness of government had declined markedly since the brief days of the oil embargo, and that while energy was still an important public issue, it was not now serious enough to merit altering lifestyles or behavior in any significant way.¹³

B.6.4 Planned Unit Development (PUD) and Cluster Zoning

Community energy systems appear to lend themselves to implementation in "planned communities," and ICES feasibility is likely to require clustering of dwelling units at a minimum and probably more complex forms of PUD that include mixed housing types or even mixed land uses. Clustering in its simplest form, involves grouping buildings together or using attached types of housing, such as townhouses. Often, a housing cluster will be centered around a cul-de-sac street, and the building units all share common yard space. Simple clustering, in itself, is a design option that can contribute to the energy efficiency of a development. Whether or not a community's motivation for encouraging clustering is related to energy, the availability of the option allows developers to design and build projects that use less energy than non-clustered developments. In realizing the energy benefits of clustering, a community that already has implemented the concept, may increase its efforts to encourage this type of development. Increasing the number of districts in which clustering is permitted or relaxing setback requirements across the board are incentives to this option.

Planned Unit Development incorporates a number of the design options discussed in chapter two: PUD zoning automatically implements them. A typical

PUD may include multi-family building units, clustering, raised density; mixed residential, commercial or industrial uses; innovative street design; and on-site recreational amenities. In addition, the PUD, "community design" concept that approaches project design as a whole, permits much greater concern for any issue such as energy. Environmental, social, and economic concerns in the past have played a major role in the design of PUD's, to a much greater extent than would be possible with more conventional development. The approach will mean greater ease of planning for ICES. Both the increased planning of PUD and the presence of specific design options like clustering and higher density can help to facilitate installing an ICES and to make the system cost effective once it is in operation.

PUD and clustering are usually voluntary provisions within the zoning ordinance. Although many developers have initiated these options on their own, local officials can take steps to encourage their use. Density and floor area bonuses, can provide real incentives to developers to make use of PUD and clustering. The energy savings realized from increased use of these options is significant justification of the bonuses given to developers. References 14-17 discuss clustering as practiced by several communities.

B.6.5 Incentive Zoning

Incentive techniques have played an increasingly popular role in land use regulation because they can induce developers to provide desirable amenities in their projects. Incentives usually take the form of density or floor area bonuses and trade development rights for construction of desired amenities. These may include open space, protection of an environmentally unique area, improved automobile circulation or special uses such as theaters. Without the bonus granted to the developer the amenities would not be economically possible but the added return from the project density increase provides the necessary revenue. Only a few communities have used incentives and bonuses specifically for implementation of energy options, and these are discussed in References 18 and 19.

The technique of using bonuses to implement energy design options is very promising. For example, a developer that was willing to modify the site design of a project to make it more energy efficient might be given a 10% increase in allowed density. The bonus granted would depend on the

design option in question and its relative level of energy payoffs. Those design options that were particularly energy conserving would warrant larger bonuses than the options that were less effective. The energy payoffs of design options are not well documented and so the process of determining their bonuses will be somewhat rough. Until the specific payoffs become known, it may be simpler to base the bonuses on the cost of the various options to a developer.

In addition to facilitating site design options, incentives may be important in the initial years of new utility technologies, not only in helping developers to absorb additional costs of those systems, but also to ensure that the systems are cost effective. The economies of scale necessary to make an ICES feasible may require higher densities for adequate performance. Density bonuses would provide both an incentive to their construction and the type of development necessary for their operation.

B.6.6 Performance Standards

The concept of performance standards has long been used in industrial zoning, and more recently it has been used to regulate land use for environmental protection. Performance standards set levels of performance for certain aspects of development. For example, in industrial performance zoning, a variety of districts are specified. Instead of listing the kinds of industries that may exist in each district, the performance ordinance specifies maximum levels of glare, noise, odor, and other effects that may not be exceeded by uses in a given district. Any land use meeting these criteria is permissible. Another example of performance controls is runoff and erosion control ordinances. These ordinances, aimed at controlling erosion during and after construction, set maximum levels of runoff that may occur. Construction techniques and control measures are left to the discretion of the developer, provided the performance standards are met.²⁰

With regard to ICES, performance standards would be necessary in implementing them. ICES may involve light industrial uses, such as central heating plants or resource recovery stations. Under conventional use restrictions and specification standards for residential districts, those uses are likely to be excluded. Performance standards that set acceptable levels of glare, noise, odor, or air pollution would be necessary to permit the presence

of innovative technology while ensuring that those technologies are not a nuisance or safety hazard to residents. Regulating new energy technologies in this way also would alleviate some of the concerns of citizens who would resist the idea of non-residential uses in their neighborhoods. For ICES in a residential neighborhood, standards would be more stringent than those listed above. Acceptable levels of glare, noise, etc. are naturally lower in a residential district and thus a greater burden for acceptance of an ICES would be placed upon the system and its unobtrusiveness.

In the same way that performance standards would be used to implement ICES in residential neighborhoods, this type of regulation would facilitate more general mixed-use design options. Energy-efficient developments that include commercial facilities, such as grocery stores or office buildings or even light industrial uses would require regulation by performance standards to permit those uses and at the same time prevent adverse effects to residents.

Another way that performance standards might be used to implement energy efficient design options is through standards for community energy performance. When the relationship between land use and site design options to energy consumption becomes clearer and more quantifiable, it is conceivable that development could be required to meet certain levels of energy efficiency. A developer would be permitted to use any design options he chose as long as energy use per unit area (per acre or square foot of floor area, for example), did not exceed an acceptable level. This type of regulation would be complex, and under present understandings of energy consumption and community design would not be possible.

B.6.7 Solar/Envelope Zoning

A major problem in effectively implementing building orientation for use of solar heat and solar collectors is likely to occur in higher density, multi-story developments--i.e., shading of buildings and solar collectors by other buildings. Special zoning will be required to protect the access to sunlight of building facades and solar collectors. This type of zoning means considering the angle of the sun and positioning of buildings with respect to each other. Envelope or solar zoning does this Under envelope/solar zoning

a number of provisions can be made to protect the use of solar energy. In Albuquerque/Bernalillo County, N.M., a zoning ordinance prohibits buildings from interfering with each other's use of the sun.²¹

More elaborate ordinances that provide for the creation of solar easements that cross lot lines are being developed. The American Bar Foundation has developed a comprehensive set of ordinances that relate to solar energy.²² These ordinances cover such things as municipal and state encouragement of solar collectors to actual protection of solar skyspace. Individual structures that use solar orientation or collectors as well as ICES that contain solar components will require solar/envelope zoning to ensure the performance of technologies and adequate direct solar gain.

Some potential conflicts between high density development as an energy option and the type of land use necessary for direct solar gain and solar collector use will involve tradeoffs in correlating the need for protection of rights and use of tall, or clustered buildings. When tradeoffs are determined, solar zoning can be adapted to implement them. For example, an ordinance might specify that in certain circumstances it is acceptable for a high density building to shade a smaller building. Based on the energy savings of the high density building versus the savings from solar gain of the other, this arrangement would provide maximum energy conservation.

B6.8 Landscaping Provisions/Tree Protection Ordinances

In communities where the value of vegetation, especially trees, to aesthetic and environmental quality had been realized, land-use regulations have been used to protect existing vegetation and to provide additional landscaping. Tree protection ordinances simply prohibit the removal of trees without approval of an administrative body. Landscaping provisions require addition of vegetation to a site after construction, usually for aesthetic enhancement although some ordinances recognize and address the value of vegetation in erosion control. Because trees and other vegetation can help save energy by cooling the environment in the summer and providing protection from wind in the winter, land use regulations that protect vegetation can be used to implement energy conservation.²³

Existing tree protection and landscaping ordinances do not address specifically the issue of the location of vegetation in relation to buildings

or other facilities such as parking lots. Landscaping requirements, especially, could be updated to provide for more strategic location of new vegetation for proper shading and wind protection. This would require developing standards for tree placement, and choice of species.²⁴

B.6.9 Special Permits

A special permit is a procedure in zoning that requires special treatment for certain uses that conceivably might not be compatible with development permitted by right in a given district. An example would be a museum in a low-density, residential neighborhood. Rather than exclude such a use altogether, the ordinance requires a special permit (sometimes referred to as conditional use, special use permit, or special exception). A special permit process involves review of the proposed use by public officials. If the use is found to be in keeping with the character and goals of the district it is approved; if not, it is denied.²⁵

Because an ICES will involve technologies that potentially could conflict with the character of districts in which they are built, the special permit process will provide a useful tool for implementing them. The nature of an ICES will require careful planning and scrutiny to ensure proper performance in a residential neighborhood, for example. In the special permit process, plans for the system would be reviewed by officials and any problems ironed out before granting approval of the permit.

B.6.10 Contract Zoning

Contract zoning is a technique by which a community imposes conditions, not specifically provided for by the zoning ordinance, on rezoning of land. For example, a community may grant a rezoning to a developer who wants to build an office building in a zone in which it is not now permitted. The community desires the project, but does not want to permit all of the other kinds of development possible under a blanket rezoning, i.e., it wants to commit the developer to building what he proposes and no more. An agreement is then made between officials and the developer wherein the developer agrees not to build anything other than the office building, and the municipality agrees not to change the zoning for a specified period. The agreement usually is

legally bound by a covenant. In this way the community is able to permit exactly the kind of development it wants without opening the door to unwanted projects.²⁶

ICES could be treated in this way. Because an ICES may not meet requirements of restrictive residential or commercial districts, a rezoning may be necessary to develop the system. Conceivably, rezoning part of a single-family residential neighborhood to light industrial use might be necessary to legally permit an ICES. In such a case, all other light industrial uses possible under the rezoning would be undesirable. The contract approach would provide a way to permit the ICES without permitting other inappropriate industrial uses.

Contract zoning, however, is a legally questionable tool. Some state courts have refused to validate it; others have questioned its application in specific circumstances. It should be used only with discretion and foreknowledge of its legal standing.

B.6.11 Flexible Subdivision Regulations

Subdivision regulations, that control the division of raw land into developable tracts and lots, specify procedures for platting, (the actual division of land) and set standards for necessary improvements. Subdivision regulations define how streets, sewers, water mains, and storm water drainage facilities will be constructed and often provide for open space and landscaping. Many energy-efficient design options depend directly on these provisions. Street and building orientation, reduced street standards, and bike/foot paths can be implemented through subdivision regulations. Some examples of successful subdivision regulations are given in References 18-22.

Like any other conventional regulatory technique, subdivision regulations will require increased flexibility to permit and implement ICES and design options for energy efficiency. Options not currently provided for in the regulations must be added, if a community feels justified in requiring additional improvements of the developer to reach its energy goals.

B.6.12 Site Plan Review

Site plan review technically is not a land use regulation, but rather an administrative review process that is used to regulate projects being

developed under subdivision and PUD provisions. The process includes three stages: (1) a pre-application conference during which officials and the developer get a sense of each others intentions; (2) a preliminary development plan review in which major substantive review of the project takes place, and negotiations for changes are made; and (3) a final development plan review which serves to wrap up the design specifics of the preliminary plan and ensure that the project conforms with ordinance regulations. All PUDs and many special and permitted uses are subject to site plan review.

Presently the standards and guidelines used in site plan review are aimed at environmental, recreational, aesthetic, fiscal, and social considerations. Most communities have site plan review handbooks to be used by officials in the process. The issue of energy conservation has not yet been addressed in the site plan review process or in the guidelines used. However, because the process involves a good deal of scrutiny, negotiation, and revision of development plans, site plan review offers excellent opportunity to do so.

Environmental guidelines and concerns have become commonplace in site plan review processes and manuals. A site plan review guideline that relates to the energy issue might be as follows:

- Is the orientation of buildings such that, whenever possible, maximum use of solar heat is made?
- Have alternative designs to minimize street length been considered in the planning of this project?

Many other energy questions might be raised in this way.

B.6.13 Energy Impact Statements

The energy impact statement concept is modeled on the environmental impact statement. In each case, some attempt is made to assess the effect of a project on energy or environmental issues. As a regulatory device, the impact statement is used as a prerequisite to development. The developer must complete a statement and submit it with the various requests for approval that are filed. For energy, the assessment procedure would involve measuring direct and indirect energy consumption of the project. Density, circulation system, housing type of utility systems, and type of home appliances are among the things that could be considered. Energy consumption of alternative development proposals also could be included.

Based on the energy impact statement, administrators reviewing the proposal could make suggestions to improve the energy efficiency of the project. Much like a planned unit development review, this would involve substantial negotiation between officials and the developer.

In California, environmental impact statements are required by state law for developments of a certain minimum size. In 1970, energy was added as a consideration in the impact statements with the passage of the Warren Alquist State Energy Resources and Conservation Act. The Act requires that each EIS include a statement of project measures that will reduce wasteful use of energy. A number of local jurisdictions have begun to use these provisions to consider energy efficiency in their project review. At this point, the state regulations are only guidelines and do not give any authority to block energy-inefficient development. In the future, however, the regulations may be amended to grant authority to deny development permission on the basis of adverse effects on energy.

Some specific considerations in evaluating the energy performance of a development have been suggested by the Urban Land Institute.

An energy impact assessment could analyze the following factors:

- The materials used in the development.
- The construction process itself.
- The configuration of structures on the site.
- The energy required for transportation with the project.
- The analysis of alternative energy sources.
- The analysis of alternative energy systems.

Like environmental impact statements, the answers to these questions could be used to determine the importance of considering alternative development plans and design options to improve the energy efficiency of a project.

B.7 INSTITUTIONAL FACTORS AFFECTING COMMERCIALIZATION

This section focuses on the institutional factors that could hinder the public acceptance of integrated community energy system and energy-efficient design concepts.

- Will planners and other public administrators support these concepts, or will they resist them?
- How are elected officials likely to respond?
- Do existing laws governing land development and utility operations accommodate such innovations, or will changes in these laws be necessary?

Concrete answers to these questions are premature at this point, because community energy systems are still in the early conceptual stages of design. Some preliminary indications of impediments to commercialization can be identified, however, by taking a closer look at the workings of these public institutions.

The following is a list of the major barriers to the implementation of ICES and related energy-efficient design concepts which have been identified in this report. No attempt has been made to rank or weigh them against one another. Recommendations for further commercialization research also are included.

1. *Land Use Policy Changes*--Proposed changes in public policies regarding acceptable mixes of different land use, especially when incorporating ICES in restrictive residential communities, will encounter moderate to heavy resistance. Demonstrated performance of the successful operation of new energy technologies will be necessary to overcome these barriers.

2. *Information for Decision Making*--The lack of baseline energy consumption data at the community level is a serious constraint to public decision-making in the field of energy conservation. Also, data on relative efficiencies of public institutions to make energy planning decisions. ERDA is currently moving ahead with some basic research efforts in comprehensive energy planning. To facilitate the acceptance of ICES, however, further research attention should be directed at energy-efficient site design alternatives.

3. *Fragmentation of Public Institutions*--The sheer number of local jurisdictions with which ICES developers must deal is a hindrance to widespread standardization of ICES hardware and related site design concepts. Each

project, will to some extent, have to be tailored to the needs and requirements of individual communities. Massive public education and information programs will help to reduce public resistance among public institutions.

4. *Administrative Implications of Flexible Regulations*--Flexible land use regulations, which are the most amenable to the implementation of innovative energy technology and community design, also impose the highest administrative costs on both developers and public institutions. In tight financial markets, these added costs can stop development on the onset. Substantial research efforts aimed at designing streamlined administrative and regulatory procedures are needed to keep such impediments to a minimum. Research efforts should include designs of the necessary performance standards, review guidelines, and model ordinances. Figure B.18 shows the rezoning application procedure used in Memphis, Tenn. with time estimates given for each of the basic steps in the procedure.

5. *Interdepartmental Coordination*--Public decisions on ICES will require a considerable degree of interdepartmental coordination and agreement on the part of many fragmented, single-purpose public service agencies commonly found in most local governments. Both technical problems (such as the integration of various utilities within common corridors) and administrative coordination of project reviews are potentially serious barriers to the success of ICES. As the appropriate mix of integrated utilities becomes clearer to the designers of ICES, research and demonstration efforts will be instrumental in resolving technical interdepartmental conflicts and coordinating review procedures.

6. *Rigidity of Conventional Zoning*--In addition to the administrative problems posed by heavy reliance on flexible zoning techniques, the rigidity of conventional zoning ordinances and subdivision regulations constitutes a substantial barrier to ICES due to the fact that such regulations are still the predominant form of local land use controls in most communities. To date, flexible zoning techniques have been used only on a voluntary basis and only in certain zoning districts. Research efforts aimed at designing and demonstrating the utility of flexible variations in conventional land use controls will help to alleviate this problem.

7. *External Effects of ICES*--To the extent that the objectives and performance characteristics of ICES conflict or work at cross purposes with

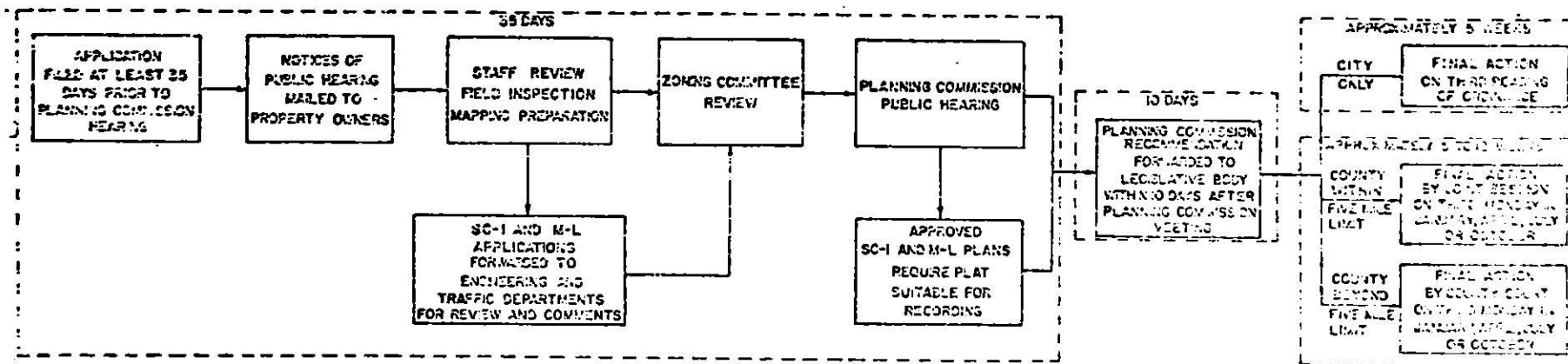


Fig. B.18 Rezoning Application Procedure

other community goals and objectives (in such areas, for example, as growth management, housing equity, and environmental quality), the external side effects of ICES will constitute barriers to their acceptance. While preliminary findings indicate that the major goals of ICES are compatible with other community goals, much more research will be necessary along these lines as the specific characteristics of ICES become clearer.

8. *State Utility Regulations*--Whether or not ICES will be classified by state regulators as public or private utilities will substantially affect the administrative complexity of their operations and their responsibilities. Upon review of the Illinois Commerce Commission regulations, it appears that an ICES is likely to be classified as a public utility (unless municipally owned), and consequently subject to all the responsibilities and restrictions that accompany that designation (including responsibilities for the provision of adequate utility services at just and reasonable rates, controlled rates of return on investment, and other restrictions governing discrimination in service, abandonment of service, and liabilities). Potential owners of ICES include municipalities, existing utility companies, developers, and the energy consumers themselves (e.g., homeowners). State rulings on how ICES are classified will affect the ability of these various potential owners to operate and manage these systems in the long run. The administrative, financial, and technical capabilities necessary for successful ownership and maintenance of ICES are a crucial factor to their ultimate success which needs much more attention.

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APPENDIX C

PRIVATE INSTITUTIONAL RESPONSE TO
INTEGRATED COMMUNITY ENERGY SYSTEMS

A Report to
The Community Energy Systems Commercialization Project

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September, 1976

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APPENDIX C
PRIVATE INSTITUTIONAL RESPONSE TO INTEGRATED COMMUNITY ENERGY SYSTEMS

C.1 INTRODUCTION

The commercialization of Integrated Community Energy Systems (ICES) depends on the acceptance of the various components and design concepts of these housing and utility systems within the building industry and among its consumers. This appendix will concentrate on the roles played by various organizational actors in the building industry; the marketplace of current and potential consumers is dealt with in another report. The emphasis will be on private, i.e., non-governmental, organizations and activities, although governmental policies and agencies often are directly or indirectly related to the functions of these private groups. The most important of the private institutions whose actions influence the potential commercialization of ICES are those from whom the financing of ICES projects could be secured -- commercial banks, savings and loan associations, and other investment developers. These financial institutions have been analyzed in another part of this study.

Among the non-governmental and non-financial agencies and organizations that will influence the commercial acceptance of ICES designs and components, four categories of organizations will be analyzed. First, in any attempt to achieve substantial change in current building designs, materials and components, or in any attempt to alter the manner in which buildings are serviced by utility systems, the influence of building codes and the many agencies, organizations, and practices involved with code standards must be addressed. Second, certain characteristics of the construction industry (which includes commercial builders, residential construction firms, subsidiary industries, and trade organizations) influence its ability to adopt new materials, designs, and building practices and influence the manner in which it adapts to changing social and economic patterns. Third, as primary participants in the building industry, craft unions and labor organizations have particular characteristics and interests of their own which contribute to the practices and the patterns of change within the industry. Fourthly, the marketability of the products of the building industry is influenced by the practices of the realtors and real estate appraisers, who, individually and through their trade associations, mediate between builders and consumers. Each of these four categories of organizations will be analyzed below.

C.2 THE ORGANIZATION OF BUILDING CODE AGENCIES AND THE PARTICIPATION OF CODE AND PROFESSIONAL ASSOCIATIONS

Over 12,000 communities in the United States have some system of building permits as the basis for authorizing construction on privately held lands.¹ These permits require adherence to some set of minimum standards for the design, materials, construction and use of buildings. Although many of these communities do not issue permits that are comprehensive enough to be considered "codes," the profusion of code administering agencies and the complexity of code variations long has been viewed as a problem within the building industry. Estimates of the number of different building codes in effect range from 5,000 to 10,000, with as many as 5,000 dissimilar ones.² Over 4,000 separate code administering agencies have been observed in cities with populations exceeding 5,000. Among these, the Kaiser Committee found more than 30,000 building code variations.³

The building code system, however, is not as disjointed as it first appears to be, nor as detrimental to the building industry and cost-conscious consumer as its critics often claim. Relatively few nationally recognized associations and professional groups, regional affiliations and state agencies are central participants in the complex process of building code formulation; they foster a recognizable organization in the system. Three private, service-oriented associations publish model codes used by many local code agencies; they continuously update these model codes and provide other facilities for their memberships. The Building Officials and Code Administrators International, located in Chicago, is the oldest (founded in 1915) of these model code associations. It has a subscribing membership of 3,400, including 1,250 code-administering governmental units, 970 associate members who are also affiliated with local code agencies, and 980 professional memberships. BOCA publishes the Basic Code Series--model codes for building design, plumbing, mechanical components, fire prevention and maintenance. The process of model code revision in BOCA is continuous, with hearings and widespread governmental, professional, and industrial participation culminating in proposals that are voted on by the membership. Approved changes are promulgated in supplemental code manuals; completely revised editions of the Basic Codes are published every three years. In addition, BOCA offers training, consultation, building plan evaluation, and various administrative services to its

membership. For purposes of participating in the process of model code formulation and revision, membership in BOCA is extended to trade associations whose products are directly controlled by building codes and manufacturers who service the construction industry. However, these trade associations pay annual dues several times greater than governmental units. In other words, industries and trades that are regulated by building codes pay for the right to be participating members within the appropriate categories of membership. These commercial memberships help to support the association's program. Trade members may testify on proposed changes or submit their own proposals. Only active members affiliated with local, state or federal governmental units, however, may vote for the acceptance or rejection of proposed changes.

Two other model code associations operate in a manner similar to BOCA. The International Conference of Building Officials (Whittier, California) publishes the Uniform Building Code series, and offers related services to its membership of building officials, governmental units, and commercial affiliates. Some form of the Uniform Building Code has been adopted by municipalities in 44 states. The Southern Building Code Congress is a smaller and more regionalized model code association. To coordinate the activities of these three model code associations and maintain some consistency in the proposed code changes is the task of the Board for the Coordination of the Model Codes, administered by the Council of American Building Officials in Washington. The Model Code Standardization Council is an informal organization of representatives of code agencies, testing laboratories, insurance associations, industries, and professional groups that advocate similar objectives.

In general, the system of building codes comprises many local governmental authorities organized through varying degrees of affiliation with nationally active model code association, professional organizations, and trade groups. It is a system marked by relatively well-developed inter-communications and is characterized by consensus-building and attempts to achieve voluntary adherence to majority decisions. However, it is also a system that remains open to influences from various special interests at all levels -- from the influence of community contractors on local officials to the pervasive impact of national industrial and economic patterns on the whole system. In

this openness (lack of rigidly defined standards and hierarchical structures) lie both the strengths and the weaknesses of the system. Its primary strength is that it achieves a sometimes remarkable degree of participation and voluntary adherence by those who either administer or are affected by building codes. Because many of these groups advocate changes in existing building codes, the entire system is involved in a continuing process of revision. The building code establishment cannot be characterized as entrenched, immovable, or unresponsive. Its principal weakness is its reliance on consensus-building and its dependence on voluntary adherence. Thus, the system changes slowly, sometimes ponderously, and lacks the ability to formulate and enforce stringent, new building standards.

The formulation and administration of building codes is an exercise of the police powers of the states. In general, this authority has been assigned to local-level governments, although the extent of this delegation of powers varies from state to state. Ultimately, code standards could be promulgated by the federal government. Clearly, state governments also could exercise complete authority for administering building codes. In fact, however, neither the federal nor state governments have historically sought to utilize this implied legal authority. The most pervasive argument against legislated and centrally administered building code standards is the recognition that the widely varying physical, economic, and social conditions within the nation and even within the states make the goal of a single, uniform building code or set of standards highly impractical and perhaps dysfunctional. If the objective of building codes is to enforce standards that serve both consumer and community needs without adding excessively to construction costs, this requires sufficient flexibility within the code system for standards to fit the differing conditions of local environments. Both the requirement for local level flexibility and the objective of efficient administration militate against unitary, centrally administered building standards.

Numerous federal commissions and state level agencies have examined the possibility of establishing national or compulsory state codes, and some have made recommendations in this direction. For example, the LaQue Panel^{*} appointed by the Secretary of Commerce in 1965, examined the possibility

^{*}In addition to the LaQue Panel, the system of building codes was examined by the Department of Housing and Urban Development as part of the 1965 Housing Act, by the National Commission on Technology, Automation and Economic Progress (1966), and by the Advisory Commission on Intergovernmental Relations, all within a three year period.

of establishing a national building code that could be adopted anywhere in the nation -- a plan similar to the flexible national codes in Canada. The consensus of opinion within the building industry and governmental officials remains, however, that national or regional building standards should be in the form of model codes, to be adopted, adapted, and administered by local code authorities to meet local conditions. It is doubtful that the additional constraints and objectives resulting from the changing availability and price structure of energy resources have either changed this position or undermined the justifications for maintaining a relatively decentralized system of local building codes.

This is not say, however, that various state and federal governmental agencies have not played a larger and more constructive role in the formulation and dispersion of uniform model codes within the past decade. By 1973, 15 states had established state-wide model codes that were available to local code authorities. Another related development was the formation of the National Conference of States on Building Codes and Standards (NCSBCS), which was first convened in 1967 and formalized as an organization in 1972. NCSBCS is made up of: (1) one delegate member appointed by each state from a relevant state-government agency; (2) non-delegate state members, also from state agencies concerned with building codes and standards; (3) associate members from federal or local level regulatory agencies; and (4) affiliate members. The organization is supported and administered by the Center for Building Technology within the National Bureau of Standards, Department of Commerce. Although NCSBCS was formed to strengthen and support the building regulatory services of the states, it accomplishes this goal through federal government support. The organization assists the states in improving their legislative, administrative, and judicial practices regarding building regulations; promotes cooperation among states and different levels of government; and consults various segments of the building industry on code-related problems and potential solutions. NCSBCS is not itself a model code association. Although it works closely with the three model code organizations, it undertakes no code-writing per se. Nevertheless, it has initiated several important code-related developments since its formation. At the request of NCSBCS, the National Bureau of Standards undertook development of standards for energy conservations in building. After several years of consultation, this request resulted in the ASHRAE Standard 90-75, "Energy Conservation in New Building Design."

C.3 BUILDING CODES AND THE COMMERCIALIZATION OF ICES

In the existing building code system, many private, quasi-public, state, and federal actors work within a complex, cooperative process of formulating model codes that are adopted in various degrees of uniformity by the agencies of local government that administer building codes. Many organizations, including building industry groups, consumer spokesmen, special interests and elected officials, often with conflicting objectives, have an input into this process. Because it draws from so many different perspectives, the code system often is slow to move, and typically it attempts to assume positions that satisfy, to some degree, all parties concerned. Second, although considerable slippage occurs between the standards suggested by model codes and those adopted by local agencies, BOCA reports that 70 percent of its membership normally follows the pattern set in the model code. A National Association of Home Builders study found that 71 percent of local jurisdictions base their codes on one of the national models. On the darker side, only one out of four jurisdictions adopts a model code without some modifications. Nevertheless, there is much uniformity among codes, and differences often are minor. Local options often are maintained for local reasons.

Radical restructuring of the building code system in the direction of increased centralization is not necessarily desirable and does not appear to be at all imminent. Assessments of the commercial potential for ICES need not be premised on such a relatively costly and unlikely restructuring. A well-developed system of arbitration and established mechanisms for change exist within the system. If ICES involves designs or components that cannot survive these processes to effect necessary code changes, it is unlikely that they would be acceptable to the existing building industry. Given what is now available on the technical components of ICES alternatives, it seems unlikely that any radical code changes -- changes that cannot be handled within the existing system -- will be necessary. However, several minor problems call for modifications in building codes and improvements in the system of code formulation and administration. Without appropriate changes, it seems likely that these factors would impede the adoption of ICES designs and components.

Within the building industry, and particularly among construction firms the system of local building code is viewed as a troublesome labyrinth of regulations and as an inhibition to innovation. In the extreme, builders decline work or claim that codes add unnecessarily to construction delays and final costs. Although no firm figures are available to verify and measure these claims, many regulations that builders find unnecessary may be beneficial to the public. Most observers feel that the complaints of the industry often are exaggerated. Code variations do add to the expense and complexity of construction, however, and written codes often inhibit builders from changing existing building practices. Even if these factors are sometimes exaggerated by builders, the mere perception of codes and code authorities as roadblocks to change is enough to inhibit innovation in the building industry.

The reasons underlying this perception that building codes inhibit change in the industry are complex. Several problems are related to the standard practices of code agencies. Typically, local code authorities issue what are called "specification" codes. These require the use of specified materials, designs, or practices in building construction. This means that most codes, in effect, favor existing materials and practices over new ones; builders are discouraged from exploring the use of alternative materials and plans because of time-consuming and costly delays involved in getting code approval for unspecified items. Code agencies often are slow to approve alternatives because they lack the resources and training for testing products at the local level. Specification codes are a particular hinderance to the adoption of energy-conserving materials and designs, because these involve a new category of code standards and often include substantial changes in past practices.

The alternative to specification codes is the use of codes that set standards for the overall performance of materials and designs. These would leave builders free to use new methods and materials, as long as they meet performance standards set by the codes. For example, the code standards in regard to the energy usage characteristics of buildings could be achieved by different builders using different materials and designs. Builders would not be required to go through the process of initiating code changes (the specification of new items), but merely to demonstrate that the proposed changes meet or surpass the authorized performance levels. While existing specification codes would slow down and otherwise hinder the adoption of ICES designs and

components, performance codes would pose no such hindrances. Moreover, more stringent standards for energy usage in buildings under a system of performance codes would encourage the adoption of appropriate ICES technologies.

Performance-type codes have, in fact, been advocated by the model code associations and by state governments for a number of years. But they have not been widely adopted by the local level code agencies, primarily because specification codes are cheaper to administer and require lower levels of expertise. Local code agencies have pointed out that, without more financial support for carrying out the administration of building codes, and in the absence of training programs and an increase in the available testing facilities, it would be impossible to administer effective performance-type codes. These constraints in the existing system could be remedied. More money could be appropriated by local communities, by state legislatures, or through federal revenue-sharing for the administration of performance codes. High professional wage scales might attract engineers with the requisite education. Training programs could be maintained by state universities, regulatory agencies or construction industries to enable building code officials to administer more complex standards. The network of private and governmental product testing laboratories could be expanded to provide services to local code authorities. Testing methodologies and evaluation procedures could be unified through state support. Such programs would increase the likelihood that local authorities would adopt performance-type codes, which, in turn, would ease the acceptance of ICES and similar developments.

A second potential hinderance to the acceptance of ICES within the existing building code systems stems from the system's general slowness to act and to undertake necessary changes. This results, in part, from the same shortage of adequate funding, training and facilities, and from the maintenance of specification codes. With state aid, these weaknesses could be corrected. A more general problem, though, is that the code associations and authorities attempt to achieve consensus within the building industry, rather than enforce policy positions. With more extensive state and federal support, code authorities might have more independence from special interests and be able to follow policy decisions made in the elected branches of government.

Haphazard model code adoption and ineffective enforcement are two other problems that might bear on the commercial potential of ICES. As previously pointed out, only about 70 percent of local code authorities base their building codes directly on the available model codes, and the majority of these do so only with locally determined modifications. These figures could be improved if model code programs were given more resources and support; the desirability of local options to fit particular community needs and the advantages of decentralized code administration could be maintained even if model codes were more effectively promulgated and more uniformly used. Model codes should be developed and applied on different levels for appropriate regional divisions. Some building code standards are appropriate for nationwide application; energy usage standards are one example; fire safety regulations, another. Other standards, e.g., those concerning building materials and designs, might be more appropriately developed on a regional or state level. Finally, programs could be initiated to develop model building codes in more detail for distinct geographical districts or metropolitan regions at the sub-state level. The adoption of model codes according to an appropriate pattern of levels would lessen the complexity of local variations and ease the problems of code approval faced by builders. Such a program could be stimulated through expanded state and federal support for model code associations, and would increase the potential for the commercialization of energy-conserving material and design options such as those included in ICES.

The enforcement of existing codes is a similar problem. Local code agencies have two primary responsibilities: (1) to enforce standards in the construction of new buildings, and (2) to conduct programs to bring existing buildings up to code standards. In both of these tasks, most local agencies are currently underfunded and understaffed. New construction code enforcement can be improved through higher appropriations and through the development of various support facilities, such as the improved model code system and the network of ancillary testing laboratories suggested above. Efforts to bring existing structures up to code can be enhanced through increased support of activities, such as the Federally Assisted Code Enforcement (FACE) Program. FACE provides funds and low-interest loans to building owners to enable them to bring their buildings up to code standards.⁴ Federal programs

that subsidize the installation of increased insulation are another example of appropriate efforts to improve code enforcement.

Finally, the commercial potential for energy conserving design and material options is lessened by the lack of energy usage standards within existing building codes. However, this is likely to be changed soon. The ASHRAE 90-75 Standards, "Energy Conservation in New Building Design," have been in the process of development and evaluation for several years. The three model code associations have conducted extensive hearings on these standards and are presently involved in submitting appropriate code changes and additions to their memberships for approval. It appears that these standards will be included in the primary model codes by the end of 1976. ASHRAE has developed a similar set of standards for existing buildings, but the acceptance of these standards will take more time.

Two questions regarding energy usage code standards remain open: To what extent will local code authorities voluntarily adopt and be able to enforce the new energy usage standards incorporated into the model codes? What effects will these code changes have on the building industry and on energy conservation? Resolution of the first question depends on the amount of support for energy conservation programs from different sources and on the existing constraints and prices of energy resources. Local code authorities would be more likely to adopt energy usage standards if there were strong support for such measures from their communities or from other levels of government. Shortages or steeply rising prices for energy resources also would increase the likelihood of the adoption of energy standards. The future enforcement of these standards can be aided through increased technical and financial support for local code agencies. BOCA, for example, has translated the somewhat technical language and calculations of the ASHRAE proposals into tables, charts, and other enforcement aids that can be more easily used by local officials.

What effect the adoption of the ASHRAE standards will have within the building industry remains to be seen. A study by Arthur D. Little & Co. for the Federal Energy Administration estimated that full enforcement of the ASHRAE standards would reduce energy consumption in new low-rise apartments by 42.7%, in new institutional buildings by 48.1%, in new retail stores by 40.1%, and in new office buildings by 59.7%. Energy consumption in single-

family dwellings under the standards, however should be reduced by only 11.3%. The technical staff of BGCA foresees only very minor changes in the current homebuilding industry as a result of the ASHRAE standards. This raises the question of whether the proposed standards are sufficiently rigorous to alter existing practices in house construction and significantly affect energy consumption. Perhaps even more stringent standards are required; this position should be supported by those interested in increasing the commercial potential of energy-conserving designs and concepts. There can be little doubt that the incorporation of high energy usage standards into building codes would enhance the attractiveness of ICES and similar alternatives.

This section has pointed out several impediments within the existing building code system to the commercial acceptance of ICES designs and components. The perception that building codes inhibit innovation in the building industry, the continued reliance on specification rather than on performance-type codes, the slowness of the system to change and its need to rely on voluntary adherence, the laxness in code enforcement, and lack of effective energy usage standards within building codes all decrease the commercial potential for energy-conserving alternatives. None of these factors, however, must be viewed as a barrier to the ICES program. From the perspective of ICES, there is no need for the radical restructuring of the building code system. The suggested changes are more modest; they work within the existing system to promote changes that will increase the potential for the acceptance of energy-conserving technologies and components.

C.4 THE ORGANIZATION OF THE CONSTRUCTION INDUSTRY

C.4.1 Construction Firms and Trade Associations

The American construction industry is highly fragmented, decentralized, and relatively fluid. In some respects, it is highly speculative and competitive; in others, it is firmly rooted in traditional practices, embedded in established patterns, and exhibits a rather limited responsiveness to the housing market. Construction involves so many different producers and categories of suppliers that no exact total is known. The Associated General Contractors of America, an organization of large contractors engaged in commercial and heavy construction, has 9500 members. The National Association of Home Builders has 75,000 members, consisting of residential construction firms and companies that service the housing industry. Moreover, there are

thousands of private builders and unaffiliated construction and contracting firms. Another characteristic of the industry is that private builders -- even large firms -- move in and out of the market; during a construction boom the industry expands, but contracts again as firms drop out of the industry during periods of less work. Other firms disband every few years at the end of a construction project to sell unused equipment for tax advantages or to drop unnecessary employees.

The organization that does exist in the construction industry is a form of horizontal stratification. Categories of firms operate, interact, and generally compete within particular levels. The Associated General Contractors (AGC) is the primary organization of the large firms. This organization conducts educational and public relations programs, and supports a small amount of research in construction practices. Its primary functions are: (1) to develop a legislative program that benefits the heavy construction industry, (2) to lobby for this program in Washington and in state capitals, (3) to represent its members in labor negotiations, and (4) to guard its membership from governmental regulation and destructive competition. Within the category of heavy construction, however, the firms compete through a bidding system for large construction contracts. These contracts are let by government and private developers, while in other cases large developers (the financiers) organize their own affiliated construction companies.

On a slightly lower level, there are organizations of specialty contractors, subcontractors, and smaller firms, all of whom engage in commercial and heavy construction but generally are not the primary contractors for large projects. Among these are the American Subcontractors Association, the Associated Builders and Contractors, Associated Specialty Contractors, the Mechanical Contractors Association of America, and the National Association of Plumbing, Heating and Cooling Contractors. These organizations conduct educational, legislative and service functions similar to the AGC for their respective memberships. The National Association of Home Builders is the primary industrial association at a lower level. It represents the interests of the residential housing industry through its legislative program, in its public relations activities, and especially in its interactions with the model code associations, housing material suppliers, testing laboratories, research institutes, and governmental agencies at all levels. Within these associations of construction firms and their respective levels and types of

construction there is competition among firms, although the degree of competition varies from region to region. The relative ease of entry into many types of construction increases the likelihood of competition. Between these levels, however, there is a relatively small amount of competition. Commercial and heavy construction firms do not normally undertake residential construction, and small builders do not have the resources for large projects or specialty contracts.

In addition, there are specialty product associations, including the American Concrete Institute, and American Institute of Steel Construction, the Tile Council of America, wood and lumber associations, and manufacturers groups. These organizations support research and development programs in their own product areas, and conduct various public relations, advertising, and legislative activities.

What impact will the organization of the construction industry have on the commercial potential of ICES designs and components? The construction industry, as a whole, would have little reason to object to ICES concepts because the construction would be undertaken by private industry. However, insofar as the principal associations are representative of the traditional interests and practices of the industry, they would have no particular interest in supporting ICES. It can be anticipated, therefore, that building industry associations would support ICES only if it appears that such a program would benefit their memberships. However, if ICES appears to foster competition among the horizontal strata of the industry, then it should be anticipated that the program would be opposed by the group which would be adversely affected. For example, if the NAHB determined that ICES represented a significant step away from single-family patterns of residential construction and this would reduce small builders' share of the housing market, the trade association would be likely to oppose the program by all means at its disposal. A shift to larger building projects, and to projects that included integrated utility systems which might require heavy construction techniques, clearly would be against the interests of small residential builders. Alternatively, however, AGC might support ICES if it saw in the program an opportunity for large contractors to increase their share of the housing market. Whether opposition or support for ICES from one of the categories of construction firms materializes must await further clarification of the technical

plans and the degree of governmental support. There is, however, the distinct possibility of opposition from any adversely affected sectors of the industry.

C.4.2 Trade Unions and Labor Organizations

In many ways, the labor unions in the construction industry are better organized than the construction firms. Within the central associations are well developed means for handling most conflicts, and the challenges from alternative organizations are not severe. The building trade unions are federated into the 3,500,000 member Building and Construction Trades Department of the AFL-CIO. The federation consists of the various craft unions, largest among which is the 800,000-member brotherhood of carpenters, followed by the laborers, iron workers, painters, plumbers, electrical workers, plasterers, and others. These craft unions operate through local union halls. The Building and Construction Trades Department is also divided among 530 state and local councils. These building trades councils coordinate the activities of local craft unions and maintain a united front for the purpose of labor negotiations. However, the dominance of the craft unions affiliated with the AFC-CIO in the construction industry is far from complete. There is still much non-unionized labor employed in construction, particularly in rural areas and in the South. Although control by the craft unions is nearly complete in most urban areas, even in the heavy construction related to energy resources and utility systems only about 70% of the labor was done by union workers in 1974⁵. Another challenge to the AFL-CIO craft union dominance comes from the independent, non-craft unions which have been expanding in recent years. These are construction unions organized on the basis of plant unions; they include all workers who work on specific construction projects, without dividing them into craft unions. Some construction firms prefer to negotiate contracts with these independent unions because they work for lower wage scales and permit greater flexibility in transferring workers from one task to another.

Despite these alternatives to AFL-CIO craft unions, it would be advantageous for ICES to seek support from this primary labor organization. Opposition from the AFL-CIO affiliates would block the ICES projects in most areas, and this opposition would materialize if the projects became identified with alternative organizations or non-union labor. Alternatively, support from

the craft unions would work in favor of ICES proposals, because the products might then receive support through the AFL-CIO educational and legislative programs. However, it should not be anticipated that support for utilization of ICES designs and components will be immediately forthcoming from the craft unions. Indeed, there are several factors and aspects of the traditional practices of craft unions that would work against acceptance of ICES projects.

Traditional reluctance of organized labor to accept new materials and methods is clearly evidenced in the construction industry. The high degree of unionization along with the proliferation of craft unions contributes to this resistance. Innovations are discouraged by demands for payment to compensate for labor saved through changes in construction practices or materials. The reasons for this resistance to change stem from a fear of the reduction in total employment and fear of the elimination of certain skills.

Craft-based construction unions rely on apprenticeship programs and field training, rather than on educational qualifications and technical training. These practices tend to enhance the traditional orientation of the membership and emphasize the closed nature of the unions. Adoption of ICES designs and components would involve the introduction of new products and practices with no clearly assigned responsibility for the classroom or on-site training of construction and maintenance workers. Neither the unions nor the firms would be anxious to assume this task unless it could be demonstrated to be financially advantageous.

Introduction of energy conserving technologies, systems, components and materials might give rise to jurisdictional disputes among competing craft unions. Solar collectors or other HVAC components which can be altered and more thoroughly integrated into building designs might lead to disputes between building and installation unions. Factory-produced components would be resisted by unions that work in on-site construction. These disputes would add new factors to the continuing disputes over modular housing techniques.

Decentralization and integration of utility and energy systems would disturb the current patterns in the construction industry. Heavy commercial construction related to utility systems has increased in importance relative to other sectors. According to a Department of Labor estimate,

energy-related construction increased from about 10% of construction employment in 1963 to approximately 12% in 1972. Certain crafts, mainly pipefitters and equipment operators, make up a large proportion of the employment in this sector. A shift in construction patterns away from large-scale utility construction would cause at least short-term dislocations, and for this reason might be opposed by particular labor unions.

These factors point to the possibility that ICES designs and components may be initially resisted by some of the dominant labor organizations within the construction industry. But this potential resistance need not be seen as a barrier to the commercial acceptance of ICES projects. It would be helpful if the ICES program would seek and receive support from the AFL-CIO craft unions in the construction industry. Failing to do this, however, there is still little reason to anticipate that labor problems would be insurmountable. The factors outlined here represent traditional resistance to change and short-term dislocation. Adequate training, support, and public relations activities would help to ease these transitions and to achieve eventual labor support for ICES projects.

C.5 THE ROLE OF REAL ESTATE APPRAISERS AND REALTORS

After the construction process is completed, another category of actors and organizations influences the commercial potential of the products of the building industry before they finally reach the consumer. Realtors who market the products and real estate appraisers who calculate the market value of property mediate between the producers and the consumers. In these roles, they are aware of consumer preferences and market values, and they may influence the commercial potential of housing and other construction products. In several respects, the current operating practices of realtors and real estate appraisers are a hinderance to the commercialization of ICES designs and components. These practices could be altered, however, and with appropriately altered professional operating procedures, realtors and appraisers would be in a position to positively influence the public acceptance of energy-conserving building designs and utility systems.

Currently the role of realtors and appraisers in influencing building standards and market values relating to energy usage and utility system designs is diffuse and indirect. Realtors and appraisers tend to deny any

involvement with the energy-related characteristics of building. No standards, guidelines, or even suggestions are published by realtor and appraiser associations to bring energy-related concerns to the attention of their memberships. The influences of these concerns in the processes of appraising, underwriting and marketing are minimal. Furthermore, there appears to be little incentive and very limited capability among realtors, appraisers and their professional associations for establishing energy-related guidelines.

There are several reasons that these professions lack concern for energy-usage standards. First, realtors and appraisers commonly have backgrounds in business and economics. Usually they have only general knowledge of building standards and practices and lack the requisite training to deal with, let alone establish or promulgate, energy-related standards in building appraisal or investment planning. Second, typically they rely exclusively on unit-in-place cost techniques. Energy design and usage characteristics enter these calculations only indirectly, so they are not yet considered significant factors. The tendency under such practices is to discourage higher initial energy-system investments and to discount energy costs as part of building investment. Third, they view their own role as that of a barometer in the market place. The most successful appraisers or investors are those most in line with the day-to-day characteristics of the market, not with long-run anticipations. "Appraisers do not make eggs, they can only tell you what people pay for them." Appraisers and realtors do not make buildings, and they deny any direct role in their commercial acceptance; they only determine what a building is worth in the current market. And this, they claim, is established by the buyers.

These characteristics and the denial of a direct role in influencing energy-related standards should not be taken as an indication that realtors and appraisers have no related influence at all. Although their job is not to educate the public, their role in relation to consumer and governmentally determined appraisal standards is complex. Building appraisals and the determination of a borrower's capacity to make an investment and keep up with mortgage costs clearly should include some consideration of the energy consumption of buildings. The addition of an energy usage assessment to lending, appraisal, and marketing practices would help to make the public aware of these considerations. Although neither realtors nor appraisers

are anxious to assume this responsibility, some members of these professions and leaders in the professional associations recognize this need and are advocating appropriate changes.

Changes in day-to-day market prices do not completely reflect the real economic conditions; often there is a lag, and rarely do market prices correctly anticipate future conditions. For their own good, realtors and appraisers must be able to anticipate changes, such as those coming from large increases in energy costs. Current practices and operating rationales among realtors and real estate appraisers are a potential hinderance to the commercial acceptance of energy-conserving building designs and utility systems. The higher initial costs of these designs are not measured against the potential savings in usage, life-cycle and utility costs. The establishment of appropriate energy standards, life-cycle and building maintenance assessment techniques for realtors and appraisers would bring these considerations to public attention and probably increase the attractiveness of ICES designs. Many technical problems involved with energy standards remain unsolved. Nevertheless, it appears that energy-usage standards could be established and administered as part of the processes of appraisal and the determination of investment potential and mortgage qualifications. However, it is unlikely that appraisal groups or lending institutions would undertake such changes through their own initiative. Changes will come only as a result of pressures from other sources or from substantial changes in existing market conditions.

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ADDENDUM A

Relevant Organizations and Associations

I. Building Code Associations, Professional Organizations, Building Product Testing Services and Related Government Agencies

Building Officials and Code Administrators International, Inc. (BOCA)
 1313 East 60th Street
 Chicago, Illinois 60637

BOCA has been one of the primary model code associations since its founding in 1915. Membership is now approximately 3400 in several categories: active governmental, 1250; associate, 970; professional, 980; trade association, 117; and manufacturers, 82. Professional staff is 17, with a board of directors from different areas of the U.S. and Canada, elected by the membership. BOCA is a private service organization for governmental officials and agencies who are responsible for administering building, zoning and housing regulations. The organization promotes the establishment of local building codes, provides the services to keep them up to date, encourages the adoption of "performance" rather than "specification" codes, supplies information on building materials and systems and on new construction practices and products, and maintains various services for local governments including consultation services, building plan and site inspections and educational programs. Publications include the Basic Code Series (building, plumbing, mechanical, fire prevention and property maintenance), various handbooks and training materials, a monthly magazine for practicing code officials (The Building Official and Code Administrator), and a bi-weekly BOCA Bulletin.

International Conference of Building Code Officials (ICBO)
 5360 South Workman Hill Road
 Whittier, California 90601

Founded in 1922, this is an organization of building code officials who have prepared and published the Uniform Building Code since 1927. This code contains a set of standards for materials and types of construction used by most cities and towns in the U.S. It has been adopted in some form by local communities in 44 states. The objectives of the organization are to promote the establishment of uniform building codes, a consistency in code practices, high standards of building safety and reasonable construction costs within the differing conditions of local code jurisdictions. The Uniform Building Code is revised annually and reissued every three years. Other publications include the Building Standards Monthly, uniform sign and housing codes, and various research and educational materials. The organization also carries on a program of research, training programs and building plan reviews.

Southern Building Code Congress (SBCC)
 Birmingham, Alabama

A model code association similar to BOCA, but smaller, concentrated in the southern states and offering more limited services. Publishes

the Southern Standard Building Code.

Model Code Standardization Council
5360 South Workman Mill Road
Whittier, California 90601

This is an informal organization of representatives from national associations and agencies concerned with building codes and standards including the model code associations, testing agencies, safety and insurance associations, professional groups and various government bureaus. It meets to suggest means for reconciling conflicts within the building code system and establishing uniform building standards.

Board for the Coordination of the Model Codes (BCMC)
Administered by the Council of American Building Officials (CABO)
Suite 100N
3900 Wisconsin Avenue, N.Y.
Washington, D.C. 20016

An umbrella organization of the model code associations which suggests common standards, negotiates uniform definitions and practices, and serves to coordinate regional codes.

National Conference of States on Building Codes and Standards (NCSBCS)
Secretariate, Office of Building Standards and Code Services
National Bureau of Standards
Washington, D.C. 20034

Founded in 1967 with one member appointed by the governor of each state, the District of Columbia, Puerto Rico and the Virgin Islands. Its purpose is to seek a cooperative solution to conflicts and inconsistencies within the building regulatory system and to assist in the development of uniform building codes where such uniformity is deemed necessary for interstate purposes. Also encourages innovation in the building industry and the adoption of uniform testing procedures through the joint NCSBCC/NBS Laboratory Evaluation and Accreditation Program (LEAP).

National Board of Fire Underwriters
American Insurance Association (AIA)
85 John Street
New York, N.Y. 10038

The National Board of Fire Underwriters, founded in 1866, became a department of AIA in 1964. In the past it has published the National Building Code (NBC), but the program is being phased out. The code applied mostly to building safety standards in regard to fire hazards.

National Fire Protection Association (NFPA)
470 Atlantic Avenue
Boston, Massachusetts 02210

This professional and industrial association issues the electrical safety codes which are used by the model code associations and most local codes.

American Society of Heating, Refrigerating and Air conditioning Engineers (ASHRAE)
United Engineering Center
345 East 47th Street
New York, N.Y. 10017

A professional association of 30,000 heating, ventilating, refrigeration and air conditioning engineers which carries on a number of research programs and establishes appropriate building standards. It makes recommendations to model code associations on HVAC standards for all types of buildings. One of its current programs is developing energy usage standards for buildings.

American National Standards Institute (ANSI)
1430 Broadway
New York, N.Y. 10018

An association of industrial firms, trade association, technical societies, consumer organizations and government agencies that serves as a clearing-house for nationally coordinated voluntary safety, engineering and industrial standards. One of its programs deals with health, safety, and product standards within the building industry.

American Society for Testing and Materials (ASTM)
1916 Race Street
Philadelphia, Pennsylvania 19103

A professional association of engineers, scientists and skilled technicians which carries on research programs on new products and produces voluntary consensus standards on test methods, specifications and practices, many of which are related to the building industry.

American Specification Institute (ASI)
134 North LaSalle
Chicago, Illinois 60602

A professional society of persons writing specifications for architectural and engineering materials, equipment and structures.

American Institute of Architects (AIA)
1735 New York Avenue, N.W.
Washington, D.C. 20006

A professional association of nearly 30,000 architects, which, among other programs, carries on research and education relevant to the building industry, construction practices and design. The AIA participates in the formulation of model codes.

American Institute for Building Design (AIBD)
839 Mitten Road, Suite 128
Burlingame, California 94010

An association of draftsmen, educators, building designers and industries which seeks to encourage high standards, efficiency, responsiveness and innovation in the building design industry.

Underwriters Laboratories (UL)
207 E. Ohio Street
Chicago, Illinois 60611

A private product testing laboratory with a staff of 2000 and four regional facilities. The laboratories conduct tests on the safety of various building materials, products, equipment and methods. Standards, classifications and specifications resulting from the tests are published, along with annual lists of building materials, fire protection equipment, heating and ventilating systems.

II. Construction Industry Associations

National Association of Home Builders (NAHB)
15th and M Streets N.W.
Washington, D.C. 20005

A 75,000 member association of residential construction companies, realtors, mortgage bankers, consultants, lumber companies and other related groups. Part of its program is to participate directly in building code and standard making activities related to house construction. NAHB is the principal trade association and interest group of the residential construction industry.

Associated General Contractors of America (AGC)
1957 E Street, N.W.
Washington, D.C. 20006

The trade association of large contractors (membership: 9500) engaged in commercial and heavy construction. Conducts education, research, information and legislative programs.

American Subcontractors Association (ASA)
402 Shoreham Building
Washington, D.C. 20005

A trade organization of specialty subcontractors in the construction industry. Membership: 4000.

Associated Builders and Contractors (ABC)
P.O. Box 8733
Internation, Airport, Maryland 21240

An association of construction contractors, subcontractors, suppliers and associates. Membership: 6200.

Associated Specialty Contractors (ASC)
7315 Wisconsin Avenue
Washington, D.C. 20014

An association of heating, ventilating, air conditioning, plumbing and electrical contractors. Membership: 6800.

Construction Specifications Institute (CSI)
1550 Seventeenth Street, N.W.
Washington, D.C. 20036

A professional association of architects, engineers, teachers and others who are concerned with the specification and documentation used in design, construction and equipment in the building industry.
Membership: 11,000.

Others:

American Institute of Steel Construction
American Concrete Institute .
American Building Contractors Association
Association of United Contractors of America
Building Research Advisory Board
Mechanical Contractors Association of America
National Association of Plumbing, Heating and Cooling Contractors.

III. Associations of Realtors and Real Estate Appraisers

American Institute of Real Estate Appraisers (AIREA)
155 E. Superior Street
Chicago, Illinois 60611

An association of 3400 appraisers of real property which formulates and enforces rules of conduct and ethics, establishes educational standards and promotes research. Publications: The Appraisers, monthly; Appraisal Journal, quarterly; Directory of Members, annual; Appraisal of Real Estate; handbooks and case studies.

National Association of Realtors (Real Estate)
155 E. Superior Street
Chicago, Illinois 60611

A federation of 50 state and 1600 local real estate board associations whose members are called Realtors (120,000) and Realtor-Associates (350,000). Promotes education, high professional standards, and modern techniques in specialized real estate work such as brokerage, appraisal, property management, land development, industrial real estate, farm brokerage, and counseling. The association also conducts research programs and supports neighborhood conservation and rehabilitation. Publications: Real Estate Today, 10/year; Journal of Property Management, bimonthly; Appraisals Journal, quarterly; National Roster of Realtors, annual. Also publishes numerous booklets, lecture outlines, and promotional materials. Affiliated with: American Chapter, International Real Estate Federation; American Institute of Real Estate Appraisers; American Society of Real Estate Counselors; Institute of Real Estate Management; National Institute of Farm and Land Brokers; National Institute of Real Estate Brokers; Real Estate Securities and Syndication Institute; Society of Industrial Realtors; Women's Council of Realtors.

National Institute of Real Estate Brokers (NIREB)
155 E. Superior Street, Chicago, Illinois, 60611

An association of 30,000 members of local real estate boards affiliated with the National Association of Realtors. The Institute offers approximately 90 courses each year covering residential office management and commercial/investment real estate.

Society of Industrial Realtors (Real Estate) (SIR)
935 15th Street, N.W.
Washington, D.C. 20005

An association of real estate brokers specializing in factory and commercial properties, and representatives of railroads, utilities, financial institutions, corporations and industrial development organizations. Conducts studies of special problems of industrial development, development of sale-lease back techniques, surveys of plants or site locations and availability.

Society of Real Estate Appraisers (SREA)
Seven South Dearborn Street
Chicago, Illinois 60603

Professional society of 18,000 full-time professional appraisers and others having general need for appraisal information but primarily employed by real estate and building businesses, savings and loan associations, life insurance companies, commercial and mutual savings banks, mortgage banking firms and government agencies. Special chapter committees prepare cost reports, land value surveys, market data and market trend reports. Publications: Appraisal Briefs, weekly; Appraisal Tapes, bimonthly; The Real Estate Appraiser, bimonthly; Directory, annual; Appraisal Information Sources. Also publishes a guide series on appraising apartments, industrial property, and residences.

National Apartment Association (Real Estate) (NAA)
1825 K Street, N.W.
Washington, D.C. 20006

A federation of 70 state and local associations of managers, investors, developers, owners and builders of apartment houses and other rental property; direct and affiliated members total 30,000. It conducts a Certified Apartment Managers Program and compiles statistics. Formerly: National Apartment Owners Association.

ADDENDUM B

A Selected Bibliography of Relevant Sources
on Building Codes and Labor Relations

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APPENDIX D

**CONSUMER RESPONSE TO INTEGRATED COMMUNITY ENERGY SYSTEMS:
A PROGNOSIS**

**A Report to
The Community Energy Systems Commercialization Project**

**A.S. Kennedy, Program Manager
J.F. Tschanz, Principal Investigator**

Prepared by

**Charles S. Lenth
The University of Chicago**

September, 1976

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APPENDIX D

CONSUMER RESPONSE TO INTEGRATED COMMUNITY ENERGY SYSTEMS: A PROGNOSIS

D.1 INTRODUCTION

The commercial potential of ICES designs, components, and installations ultimately will be determined by the response of consumers in the housing market and by public attitudes toward the provision of utility services. A prognosis of the response to ICES must assume a set of initial premises:

- (a) that financing for ICES projects is secured through means that make them attractive and reliable to investors and to consumers;
- (b) that regulatory and management problems are not a hinderance;
- (c) that zoning and building code regulations can be accommodated;
- (d) that the construction process proceeds smoothly; and
- (e) that the products and services provided through ICES are competitively priced and in other respects attractive to potential consumers.

This last premise is perhaps the most important and probably would not materialize without substantial changes in the price patterns of available energy sources and until the technologies for alternative utility systems and housing designs are better developed and widely known. Assuming that these several conditions can be met, this appendix will attempt to assess the potential consumer response to ICES by concentrating on the most important characteristics of the systems, by drawing parallels with public attitudes toward and consumer evaluations of similar developments, and by summarizing the factors that might hinder the public acceptance of ICES projects.

D.2 CHARACTERISTICS OF ICES PROJECTS

For the purposes of this analysis, it is necessary to proceed on the basis of what are presumed to be the most important market-oriented characteristics of ICES designs and components. These characteristics, in turn, evoke a series of research questions.

• First, it is likely that any ICES project will involve a relatively high level of community planning. The concept of planning in some communities has become identified with a very narrow range of regulatory activities designed to protect property values and maintain existing housing patterns. Thus, in some usages a planned community is little more than one in which

commercial developments are separated from areas of conventional residential housing. This form of regulation normally is accomplished through zoning and the issuance of building permits. ICES projects would involve a much more sophisticated concept of planning. In addition to a much more highly structured and interactive physical environment, planning ICES projects probably would involve social and even political aspects of community living. For example, the social life of the community might revolve around recreational facilities held in common. Backyard swimming pools would be discouraged in favor of larger neighborhood facilities; backyard garden plots might be moved to designated areas on the edge of the community, as is common in Europe. Although this might entail some loss of privacy and independence, the community facilities could be much more extensive than normally available to individual families. For example, recreational facilities might be on the order of community-held country clubs. To plan and administer these community amenities would probably involve a community political organization--a participatory community association with at least some of the functions of a small municipal government. Would this unusual degree of community planning be an attractive feature to consumers? To whom and to what groups and categories of American society would this be attractive?

• Second, a most significant aspect of ICES projects will be the integration of utilities and services into the community. The utility systems, regardless of their precise technical components, will be modularized and incorporated into the design and daily functioning of the community to a much higher degree than in conventional housing patterns. This will involve:

- (1) electrical generating facilities within the community environment,
- (2) solar collectors or other similar components built into the structures,
- and (3) the treatment, disposal, or re-use of waste products by the community.

These integrated utility and community maintenance systems will be shared (perhaps even owned) by a community corporation. The changes from conventional utility systems in which individuals independently subscribe to services from suppliers outside of the community will be substantial. These factors bring on two recurring problems: opposition to the location of utility and waste-disposal facilities close to residential areas, and the capability of communities to institutionalize the maintenance of these services.

• Third, ICES designs can be expected to include relatively high living densities. Housing densities that range from those comparable to conventional town-house developments up to those of high-rise apartments traditionally have been attractive to only certain categories of American society. ICES projects, based on high-density housing, will face two obstacles to consumer acceptance, i.e., the continuing lure of suburban lifestyles and the social conditions that tend to accompany high-density living, e.g., higher crime rates, social instability, and community conflicts. ICES projects must offer an unusual set of amenities to overcome these factors and to attract housing consumers.

• Fourth, the attractiveness of ICES projects will be influenced by the public attitude toward energy conservation. Increased awareness of natural resource limitations, heightened concern for the environment, and a renewed emphasis on an ethic of conservation clearly would make ICES alternatives more attractive. Higher prices for energy and the constraints imposed by fuel shortages would affect consumer decisions. The relevant questions are three:

- (1) To what degree is there an energy-consciousness within contemporary American society?
- (2) To what extent does this consciousness influence American behavioral patterns and consumer decisions?
- (3) Under what conditions is this awareness of energy consumption likely to change?

This analysis will attempt to find parallels to the characteristics of ICES projects within the existing housing market, within consumer research on housing patterns and preferences, and within certain social science materials on public attitudes and behavioral patterns. In so doing, the response of housing consumers to these design options will be projected, the relevant research questions will be examined, and a number of factors that may hinder their acceptance will be outlined.

D.3 RESEARCH ON HOUSING DECISION, COMMUNITY ALTERNATIVES, AND CONSUMER EVALUATIONS

Research sponsored by the Department of Housing and Urban Development (HUD) on the potential of Modular Integrated Utility Systems (MIUS) was undertaken by Oak Ridge National Laboratory in 1974.¹ Although the technical

and financial aspects of the ICES project are substantially different, there are similarities between the MIUS and ICES projects with regard to projected community characteristics and potential consumer responses. The MIUS report, therefore, is a good point at which to begin a review of the relevant literature. This analysis will note several weaknesses in the MIUS report, however, and bring it up to date with more recent materials and conclude with a conflicting assessment of several of the relevant factors.

In examining the commercial potential of modular integrated utility systems, the Oak Ridge report assumed that the system will be attractive to consumers. This assumption was based on questionable evidence, curious reasoning, and a most optimistic reading of several social indicators. The suggested commercialization techniques were premised on the condition of equal availability and even dispersion of MIUS-serviced housing to all categories of American society. Such a premise contradicts nearly all available evidence on housing patterns, particularly in highly-planned communities. As will be examined below, demographic and survey data from highly-planned communities shows a distinct over-representation of relatively high income groups with above-average educational backgrounds. The poor, the less well educated, the non-professional, and minority groups are greatly unrepresented in proportion to their percentages in the total population. Market projections based on equal penetration to all demographic categories lead to clearly unrealistic assessments of the commercial potential of these developments.

To justify these optimistic assessments, the MIUS report assumes that the philosophy of a highly planned community is a major attraction to consumers in the housing market. To document this claim, the report cites a study by Robert B. Zehner which showed that 51% of the residents of the "new town" of Columbia, Maryland, were attracted by the idea of a planned community. Columbia, however, is one of the earliest (undertaken during the 1960's), most publicized, and relatively successful of the new town developments in this country. Moreover, it is located in the highly atypical Washington, D.C.-Baltimore corridor. It is highly unlikely that the development would have been as well received in other parts of the country. Perhaps a better way to interpret the Zehner findings would be to say that even in Columbia only slightly more than half of the residents cited a planned environment as a particularly attractive feature. Forty-nine percent mentioned other features,

such as location and housing costs, as more attractive features of the community. The same study found that in Reston, Virginia (a similar new town development in the same area), only 31% responded that planning was the most attractive feature. The MIUS claim that the philosophy of a planned community is attractive to contemporary housing consumers appears to be based on an overly optimistic interpretation of highly selective and misleading data. Other evidence presented below will lead to a different assessment of consumer attitudes in the housing market.

The MIUS report is also based on a very optimistic appraisal of public attitudes and behavior in regard to energy conservation. To quote the report (p. 4.10.5): "Informal observation suggests a positive public attitude toward conservation." To support this assertion, the report points out the decline in large car sales during the fuel shortage of late 1973, and notes that the rate of increase in electrical consumption lessened after this period. Both of these indicators, however, are very ambiguous. Higher fuel prices, long lines at gas stations, and discouraging economic conditions influenced the temporary decline in large car sales; the decline cannot be seen as necessarily an indication of a new conservation ethic. Similarly, the slowing down in electrical usage also came during a period of general economic decline and higher utility rates, and in conjunction with changes in the advertising strategies of utility companies to discourage increased home consumption. The question of an ethic of conservation that is capable of changing conventional behavior patterns needs to be more carefully examined.

The MIUS report does cite some important evidence on the public attitudes toward utility services. For example, the dependability of utilities rates high in the public mind, but when utilities introduce any sort of service interruption the consumers' attitudes toward the utility tend to be negative in all respects. Second, there is oftentimes opposition to the location of utility components within the vicinity of residential areas. This is particularly true when there is potential air pollution, noise, or visual obstructions. Any changes in current utility systems must be able to minimize these effects to dispel public apprehensiveness. Third, the conventional public attitude toward utilities is that they are services generated by some outside organization and then brought into individual homes or apartments. Utilities generally are not seen as a function of communities, and there is

likely to be initial opposition to the concept of utility services that are integrated into communities and maintained through community organizations. Fourth, great opposition is expected to independent, modular utility systems by the large utility companies. This opposition is not likely to be overcome by the desire of the utilities to enhance their public image and to appear less monopolistic, as is suggested by the MIUS report.

The weaknesses of the MIUS report demonstrate the need for a more comprehensive examination of the available literature. Several types of materials are relevant: research on consumer decisions in the housing market, community profiles on planned and less-planned residential developments, studies on public attitudes regarding energy consumption, and analyses of several recent, government-sponsored, new community programs.

A study of "Planned Residential Environments" made for the Department of Transportation² found several responses relevant to the commercial introduction of ICES designs. The study surveyed people's overall responses to different degrees of community planning and residents' evaluations of various features of these planned residential environments. Ten communities with varying degrees of community planning were chosen. Within these communities 100 to 200 households were selected randomly; a detailed, hour-long interview was administered to a predetermined member of these households. Over 1200 interviews were administered for the study. The communities included Columbia and Reston as examples of highly planned residential environments on the periphery of large cities; two new, highly planned urban area developments; and one older highly planned suburban area. Communities that were less planned also were chosen in each of these categories for purposes of comparison. For example, Radburn, New Jersey, which is a highly planned, older suburban area was matched with Glen Rock, New Jersey, a less-planned, older suburban area.

The study showed that the assumption of equal attractiveness and even dispersion of planned communities to all social groups (as was done in the MIUS report) is misleading. Highly planned communities tend to have residents with higher levels of education; whereas communities that are comparable except for a lower level of planning, have residents with lower educational levels. In Columbia and Reston, for example, over 40 percent of married couples both had bachelor's degrees or more. In the less-planned, peripheral

communities of Crofton and Montpelier, New Jersey, these percentages were 24 and 36, respectively. Within the highly planned category of communities, 42 percent of married couples had B.A. degrees; within the moderately planned communities, the number was 30 percent; within less planned, 18 percent. Nationwide in 1967, only 15 percent of the heads of households had college degrees, with an even lower percentage for both husband and wife.

As the study points out, these differences in education level are indicative of other social and psychological characteristics of the communities, characteristics that would influence the attractiveness of these communities to different groups in the society. The higher preference for planned communities among the more highly educated groups in society is not simply a consequence of past residential environments, nor can it be accounted for by the current economic conditions of the residents. The degree of community planning does not correlate with the average income of residents, for many wealthy residential areas have rudimentary community planning. Moreover, planning is not widely viewed as an attractive feature of communities. Within the ten selected communities, an average of only 12.7 percent mentioned the concept of a planned community as one of the favorable features of their residential area. This percentage reached a high of 51% in Columbia, with negligible responses in six of the ten communities.

The implications of these findings for the potential consumer response to ICES are both positive and negative. Planned communities tend to be particularly attractive to highly educated people and correspondingly less attractive to people with less than a college education. Unless this pattern changes, the potential market for future planned communities is limited. Given that education level often is an indicator of other social and community characteristics, it should be anticipated that planned community environments tend to be atypical; that is, unconventional in a variety of respects relative to dominant American characteristics.³ Residents of more highly planned communities were found to be lower on a scale of status consciousness than those of comparable income brackets in less-planned communities. It is reasonable to assume that these atypical residential environments are not equally attractive to all social groups and that the concept of a planned community has a rather limited social appeal.

The Lansing study² also examined the residents' community satisfaction

within different site designs and density levels. A surprising finding was that among residents of linear single-family, townhouse row construction, multiple-structure-enclosed and multiple-structure-open townhouses, the type of construction and site design had no noticeable effect on resident satisfaction. Of the site plans in the study, only single family cul-de-sac was rated differently from the overall average. However, housing density influenced the degree of residents' satisfaction with their community. Satisfaction was noticeably higher in the least dense category (under 2.5 dwellings per acre), and lower in the neighborhoods of highest density (between 12.5 and 25 dwellings per acre). In areas of 2.5 to 8.49 dwellings per acre, the density seemed to have little effect on the reported community satisfaction. Overall, the correlation between density and community satisfaction was not particularly strong. Density influences satisfaction indirectly through a variety of factors such as privacy in the yard, neighborhood noise levels, and the adequacy of outdoor and community facilities. Given these factors, it is possible from the consumer standpoint to design a relatively high density community that is attractive because it meets other criteria. In fact, the best predictor of community satisfaction was not density, but rather the extent to which the neighborhood was "well kept up." Other important factors were the compatibility of neighbors, the social similarity within the neighborhood, and the noise level. The best predictors of low levels of community satisfaction were related to a feeling that the dwelling unit was a bad investment, a lack of neighborhood compatibility, and poor community maintenance.

Another, more detailed analysis of public attitudes and consumer decisions relevant to housing and community designs was undertaken by the Center for Urban and Regional Studies at the University of North Carolina.⁴ The analysis, titled "The Community Profile Series," and funded under a grant from the National Science Foundation program for Research Applied to National Needs, examines the performance of new community developments. It is the most extensive attempt ever undertaken to use social science survey techniques to analyze the demographic characteristics and residents' evaluations of new communities throughout the nation. The findings of the study are relevant to future projects and to governmental policies on housing development, including those that involve energy-conserving designs and components.

The "Community Profile Series" is based on data gathered through extensive probability sample interviewing in fifteen "new communities" and in a

control group of thirteen less-planned communities. The interviews examined the residents' motivations for moving into these communities and their evaluations of current and previous neighborhood environments. Residents rated their homes, neighborhoods, community facilities, and developer. They specified what types of facilities they wanted most in their communities and indicated which needed financial support. Data were provided on the income levels, racial composition, and housing types within the communities, as well as residents' attitudes toward these. Finally, the interviews sought the overall appraisal of the communities as places to live.

The thirteen target communities were chosen through a careful selection process to be representative of the entire category of new communities. The basic criteria were: (1) located in continental U.S.; (2) under construction since 1960; (3) nonspecialized (to exclude resort and retirement communities); (4) planned for an eventual population of at least 20,000; (5) population of 5,000 or more as of January 1, 1972; and (6) received no federal assistance under Title VII of the Housing and Urban Development Act of 1970. From the initial list of communities meeting these criteria, eight were selected randomly: Elk Grove Village, Illinois; Park Forest, Ohio; Foster City, California; Laguna Niguel, California; North Palm Beach, Florida; Sharpstown, Texas; Valencia, California; and Westlake Village, California. Five more target communities were selected on the basis of additional criteria: Columbia, Maryland (over ten percent black population); Reston, Virginia (outstanding design); Lake Havasu City, Arizona (free-standing); Irvine, California (projected population of over 150,000); and Park Forest, Illinois (a completely new community). These 13 target communities were intended to be representative of all U.S. communities that met the criteria defined above.

Two more communities were selected for interviewing to assure the inclusion of housing developments that were participating in the Federal New Community Program: Jonathan, Minnesota, and Park Forest South, Illinois. Both of these communities had fewer than 5,000 residents in 1972, and therefore were not included in the combined new community profile. Each of the new communities in the sample was paired with a less-planned control community that was similar to the target community with respect to age of housing, price range, housing type, and community location. No other selection criteria were used for the thirteen control communities; this means that this control group is not intended to be a scientific sample of less-planned communities.

Data were gathered using a 90-minute interview with residents selected on the basis of a clustered probability sampling technique. A total of 2,838 interviews was administered to residents of the new communities; 1,321 interviews were made among residents of the control communities. Responses from the 13 target communities were weighted according to each community's probability of being sampled (based on the community population), assuring that the combined figures are closely representative of all new communities in the U.S., as defined by the sampling criteria.

The analysis of the data revealed several comparisons between the new communities and the less-planned control communities which are relevant to proposals for expansion of planned community development. (See Table D.1). In terms of demographic characteristics, new communities were shown to have a better racial mix, a slightly different age group composition, higher levels of education, and more white-collar occupations. Minority groups, especially Blacks, were greatly underrepresented within the control communities. Although the new communities had a somewhat better racial mix, the 3.1 percent Blacks was less than a third of their proportion of American society. Racial balancing may be a goal in at least some of these planned communities, but it is one which remains largely unfulfilled. In terms of age, the household heads in new communities were slightly older than in the control communities. This finding, in conjunction with the higher percentages of professional and white-collar employees, indicates that the new communities tend to be more popular among well-established, higher-status groups.

The ten percent difference in residents with a college education, however, certainly does not allow a distinction to be made between the two categories of communities in terms of white-collar and blue-collar communities. Both categories contain a mixture of occupations and educational backgrounds. The new communities were slightly less family oriented, with a higher percentage of unmarried adults and married couples without children. The educational and occupational differences are reflected in the family income comparisons. For example, the less-planned communities had a higher percentage of households with incomes of less than \$15,000 per year. These differences, however, were in the range of only two to three percent.

In terms of the residents' motivations for moving to their community, a significantly higher percentage of respondents in the new communities cited

TABLE D.1A Comparison of Thirteen New Communities and Thirteen Control Communities

<u>CATEGORY</u>	<u>RESPONSES (Percent of Respondents)</u>	
	<u>13 New Communities</u>	<u>13 Control Communities</u>
<u>1. WHO LIVES IN THE COMMUNITY?</u>		
<u>Race</u>		
white	95.7	97.6
black	3.1	0.6
other	1.1	1.9
<u>Age of Household Head</u>		
under 40	49.4	52.7
40-50	32.8	29.7
55 or older	17.7	17.6
<u>Education of Household Head</u>		
High School Graduate or Less	27.8	36.6
Some College or College Graduate	48.1	42.9
Graduate or Professional Training	24.1	20.6
<u>Occupation of Household Head</u>		
Professional or Managerial	59.2	55.9
Other White Collar	18.9	18.3
Blue Collar	21.9	25.9
<u>Family Income in 1972</u>		
Under \$10,000	11.7	12.3
\$10,000 to \$14,999	22.0	25.9
\$15,000 to \$24,999	46.9	44.5
\$25,000 or more	19.4	17.3
<u>2. REASONS FOR MOVING TO THIS COMMUNITY?</u>		
<u>Community Facilities</u>		
Health and Medical Facilities	2.0	1.5
Public Schools	15.2	14.7
Recreational Facilities	11.6	6.4
Shopping Facilities	8.6	7.3
<u>Physical Environment</u>		
Appearance of Neighborhood	25.5	26.0
Climate	20.8	23.3
Nearness to Natural Environment	25.7	28.5
Overall Planning of Community	22.9	7.1

TABLE D.1 (Continued)A Comparison of Thirteen New Communities and Thirteen Control Communities

<u>CATEGORY</u>	<u>RESPONSES (Percent of Respondents)</u>	
	<u>13 New Communities</u>	<u>13 Control Communities</u>
<u>3. RESIDENTS' RATINGS OF COMMUNITY FACILITIES</u> (percent: excellent or good)		
Child Play Areas Near Home	75.0	66.3
Health Facilities and Services	65.3	53.8
Recreational Facilities	76.8	62.3
Schools	79.0	79.9
Shopping Facilities	66.9	62.5
<u>4. RESIDENTS' OVERALL RATING OF COMMUNITY</u> (percent: a very good place to live)		
All Residents	51.1	45.8
Single Family Home Residents	51.4	45.5
Townhouse/Rowhouse Residents	60.0	51.5
Apartment Residents	49.2	44.8

Source: Community Profiles - Spring, 1973. New Community Development Project, Center for Urban and Regional Studies, University of North Carolina, Chapel Hill, North Carolina.

community facilities as an attraction. Over 38% of the new community respondents mentioned medical facilities, school, recreation opportunities, or shopping areas as a reason for their move into the community; only 29.9% of the control community respondents replied in similar terms. Similar differences also were noticeable in the evaluation of the physical environments of the communities. Slightly higher percentages in the control communities mentioned neighborhood appearance, climate, and nearness to nature as community attractions. The greatest contrast, however, came in the respondents' attraction to the overall planning of the community. Nearly 23% of the new community residents mentioned planning as a feature which attracted them to the community; the comparable figure within the control communities was only 7.1%.

Contrasts between individual new communities and their matched control community were, in some cases, very large and in others inconsistent. For example, 47% of the respondents in Columbia, Maryland, moved to the area because they were attracted by the overall planning of the community. The corresponding figure within the control community paired with Columbia was only 1.6%. Only 4.1% of the respondents in the new community of Sharpstown, Texas, were attracted to the community because of its overall planning; whereas the figure for its control community respondents was 10.4%. The attractiveness of community planning ranged between the high of 47% and low of 4.1% for new communities, and between 19.1% and 0.9% for control communities. Because of these large variances and inconsistencies, the findings are somewhat ambiguous and must be interpreted carefully. It would seem that planning should be cited almost by definition as an attractive feature by residents of a planned community. "

In general, residents of the new communities rated the community facilities much higher than those in the control communities. Approximately 12% more gave very good ratings for neighborhood play areas, community recreational facilities, and medical services. The exceptions to these higher ratings were for shopping facilities and schools. Residents of the control communities rated their schools slightly higher, an evaluation that could be related to different educational expectations. The dominant contrasts were reflected in the overall rating of communities. Three percent more of the new community respondents rated their community a very good place to live (59% vs. 55.9% in the control communities.) The greatest contrast came within the category

of townhouse and rowhouse residents. Sixty percent of new community residents in this category of housing rated their communities a very good place to live; whereas only 51.5% of townhouse or rowhouse residents in control communities gave this response. One possible implication of this finding is that more highly planned communities are especially suitable for this type of housing design.

In all categories of services, the new-community residents rated the performance of their community association significantly lower than did residents of the control communities. Unfortunately, this does not indicate anything about the operations of these associations directly and may simply be the result of differing anticipations. Planned community residents would be likely to have much higher expectations for their neighborhood associations and to express disappointment when the associations do not meet these expectations. If the concept of the community association is broadened to include measures of neighborliness, neighborhood participation, and community feeling, then the new communities rate slightly higher than the control comparisons. Perhaps these factors help to make residents of the new communities more receptive to higher density housing. Among new community residents, 69.9% would not oppose the expansion of townhouses or rowhouses; 71.6% would not oppose the expansion of garden apartments; and 20.1% would not oppose high rise apartments. The figures in the control group were 57.8, 61.5, and 17.6 percent, respectively.

Because it is the most extensive survey research on new communities in this country, the "Community Profiles Series" cannot be ignored, even though its diverse findings are not easy to interpret. The study extensively documents and analyzes characteristics of new communities. According to the report, communities that place more emphasis on planning tend to attract higher percentages of residents with: (1) high levels of education, (2) white collar employment, and (3) higher incomes. Minority groups and low-income households are underrepresented in both planned and less-planned communities; the degree of underrepresentation is even more extreme in the latter category. This indicates that new community developments are most attractive to certain categories of the population, and that these housing developments have not achieved success in promoting social policy goals such as mixed-income or multi-racial housing.

The study also shows that there can be no clearcut distinction made between planned and less-planned communities on the basis of the degree of satisfaction expressed by the residents. All types of communities received mixed ratings of approval and disapproval; within the planned communities, there was often as much variation in the degree of resident satisfaction as between these and the less planned communities. The level of expressed satisfaction on all items varied by no more than 15% between the two categories of communities. These findings point to two underlying factors: (1) that there is no clear, generalizable definition of new communities in this country, and no common conception of what the features or attractions of a planned residential environment are or should be; and (2) that the existing new communities have not been totally successful in achieving both residential satisfaction and public support. These facts suggest a much more pessimistic assessment of the commercial potential for projects, based on a philosophy of community planning, than was assumed in the MIUS report.

To assume that the existing patterns of housing and community development in this country are mostly reflections of underlying residential preferences is more realistic. The residents in both the 13 new communities and the matched control group rated their communities relatively well and cited different features of their particular community environment as attractive. The facilities of a more highly planned community (e.g., health services and recreational facilities held in common) are rated more highly by residents of these areas; whereas, privacy, closeness to nature, and the lack of crowding are more highly valued by residents of less planned areas. In short, different degrees of community planning are related to the underlying preferences of community residents and to different values in American society.

This relationship, however, is complex; consumer preferences are themselves shaped by market factors. Although builders, developers, and policy-makers are constrained by the existing social and economic contexts, their decisions and the future patterns of housing and community development are not determined solely by current consumer preferences. Consumers also are constrained and must accept and learn to adapt to the limited set of housing alternatives presented to them by builders, developers, and the effects of public housing policy. The development of more highly planned communities, although constrained by existing residential preferences, can be a factor in changing

these patterns to the degree that these projects are successfully established.

This analysis shifts the responsibility for the potential commercial acceptance of more highly planned community developments from the consumers to the builders, the financiers, and the relevant public policies. To assume the popular appeal of a philosophy of community planning in the face of the available evidence is to assign the costs of change and acceptance to the public at large. This assumption is unrealistic and decreases the potential success of these programs. The ICES program must assume that planned community development is not particularly popular within the current housing market. Facing this obstacle, the program must adapt its proposals as much as possible for more energy-efficient designs and components to existing housing preferences. To expand its commercial potential the ICES program should work to accommodate different community types. Evidence that higher living densities tend to be more acceptable in more highly planned communities is encouraging. The ICES proposals should take advantage of this factor to encourage certain types of community development. However, to increase energy conservation within residential housing while maintaining the existing quality of life could involve some changes in current lifestyles. The ICES program should consider mechanisms for accommodating varying lifestyles to achieve the greatest degree of program flexibility while maintaining the present quality of life.

D.4 RESEARCH ON PUBLIC ATTITUDES TOWARD ENERGY CONSERVATION

In addition to revising the assessment of the popularity of planned communities and the steps necessary to achieve their commercial acceptance, it is necessary to re-examine the assumption of a widespread ethic of conservation which was made in the MIUS report. As the report pointed out, there were numerous indications of a slowing down in the growth of energy consumption following the fuel shortages of 1973. These trends seem to have continued in some categories of consumption (e.g., residential). Yet the question remains, should these reductions in the rate of increase in energy consumption be interpreted as an indication of a growing ethic of energy conservation? Alternatively, the consumption rate changes could be accounted for by rising prices, decreasing economic prosperity, fuel shortages, or the influences of the extensive public relations campaign to conserve energy and

prevent a national crisis. These alternative explanations can be examined best by turning to materials from social survey research that examined energy conserving behavior in some detail.

During the fuel shortages of 1973 and early 1974, the Continuous National Survey (CNS) project of the National Opinion Research Center (NORC) at the University of Chicago was tabulating monthly surveys of public behavior and attitudes on a number of governmental concerns and community services. The project, funded by the National Science Foundation, was an attempt to establish a continuing social survey program that would monitor attitudinal and behavioral trends and provide timely social science data to a variety of users. Numerous federal agencies, including the Department of Transportation, the National Institute of Education, USDA and HUD, participated in the program, by submitting questions relevant to their programs and by receiving the survey results. The CNS worked on a four-week interviewing cycle using a full national probability sample and NORC's well-developed survey analysis system. The program went through twelve interviewing cycles from April, 1973, to May, 1974.

Cycles eight through twelve of the survey contained items designed to monitor public opinion on the energy shortage and individual energy usage.^{5,6} One set of questions concerned driving habits and the individual's use of gasoline. A second set of energy-related questions, more relevant to this ICES study, dealt with energy consumption in the heating of homes and apartments. The interview responses showed that substantial proportions of the population had adopted measures to cut back consumption of heating fuels. In cycles nine and ten (during the winter of the fuel shortage following the Arab oil embargo), 79% of the national sample reported some type of energy conservation measures in their places of residence. These were, however, largely temporary measures: 72% reported lowering temperatures in their house or apartment; 13% reported closing off rooms.

In cycles eight, nine, and ten respondents were asked to compare the temperature at which they kept their house or apartment in the winter of 1972-73 with that in the winter of 1973-74. Among those able to control the temperature of their dwelling unit, 61.3% indicated a lower daytime temperature during 1973-74; 34.9% indicated no change in temperature; and only 3.8% reported a higher temperature. The temperature reductions were largely (81%) between one and five degrees. For nighttime temperatures, 45.9% reported

lower household temperatures in 1973-74, and 47.8% reported no change. Overall, 65.6% of the respondents reported lower daytime or nighttime household temperatures in 1973-74 than in 1972-73.

Higher fuel costs were an important cause of this fuel-conserving behavior. Unfortunately, there were no data for comparing fuel reductions with area-wide fuel costs. However, the distinction between homeowners and dwelling unit renters was significant in this regard. Homeowners use and pay for heating fuels directly. However, renters often share fuel costs with other building tenants, are billed indirectly for heat through the rent, or have no individual control of the temperature within their dwelling unit. These factors reduce the incentives for adopting fuel-conserving measures. Moreover, renters lack incentives for making energy-conserving capital improvements. It was not surprising, therefore, that renters showed lower rates of fuel conserving behavior than did owners. More owners than renters had lowered the temperature of their dwellings during the winter of 1973-74. Over 83% of the owners reported efforts to cut use of heating fuels -- 10% more than renters. Excluding the renters who were unable to control the temperature of their dwelling, the difference between owners and renters was still 7%.

Another way to examine the influence of changing prices is to compare the differences in conservation measures across fuel types. Fuel oil users encountered both shortages and the severest price increases. To the extent that these factors motivated conservation practices, one would expect to find the highest incidence of energy-conserving adaptations within this category of users, and indeed this was the case. The percentage of fuel oil users who lowered their household temperatures was significantly higher than that of the users of other energy sources. Similarly, more fuel oil users reported attempts to cut down on fuel consumption. In cycle eight (November 23 to December 20, 1973) at the height of the effects of the oil embargo, 75% of the fuel-oil-using households reporting making temperature reductions. Among natural gas, propane and electricity users, who did not face such severe price increases, between 51 and 57% reported temperature reductions. Among coal users, only 17% of the households reported reductions. These wide variations evened out somewhat during the following months.

These indications that conservation behavior was undertaken in response

to fuel price increases make the assumption of a largely voluntary conservation ethic less plausible. The large percentages of respondents who reported various conservation measures were evidence of an increased awareness of the limitations of energy resources, and demonstrated the penetration of the public relations campaign designed to avoid a national fuel crisis. However, they give no clear indication of a mushrooming ethic of conservation independent of these other factors. The evidence shows that the measures which were adopted to conserve energy in households were mostly short-term changes that were easily instituted and could be just as easily reversed. Relatively few households made changes or investments that were more permanent and that could be justified only in terms of fuel savings over a number of years. Only 6.5% of all homeowners reported adding storm windows or doors; 7.8% reported adding weather stripping or sealer to windows. Less than 5% changed their home heating equipment. Given these findings, the extent and characteristics of the public's energy consciousness remain uncertain.

The survey also included several questions related to utility systems and alternative sources of energy. On the question of public attitudes toward the location of electrical generating facilities, 61% indicated that at present there was no such facility within the community area. Sixty-four percent said they would oppose the construction of a coal-fired generating plant within their community area; 33% gave unfavorable responses to the location of a nuclear plant in their area. In both cases, opposition was based on health factors and fear of pollution and environmental deterioration.

In regard to alternative energy sources, there was strong support for the development of solar technologies. About 40% replied that they would be willing to invest \$900 to \$2,000 to help equip their house or apartment with components that could utilize solar energy for heating and cooling. Another 24% said they would be willing to invest over \$2000 for this purpose. Projecting a doubling of their present heating bill over the upcoming year, a full 43% said they would be willing to pay \$1,000 to \$4,000 for solar equipment; 16% said they would pay over \$4,000. Eighty-six percent thought it would be a good idea to start equipping public buildings, such as schools, with solar heating and cooling equipment.

These findings are relevant to the ICES program in several respects.

The somewhat more pessimistic assessment of the degree and nature of energy consciousness in American society than seen in the MIUS report means that the ICES proposals may not assume immediate public acceptance. Public awareness of energy resources and energy-related national concerns have increased since the 1973 fuel shortage. Yet, it is not clear that this public awareness has produced a significant level of long-term changes in behavioral patterns. Most changes appear to have been in the nature of temporary behavioral adaptations. In light of this evidence, it seems unrealistic to assume that an expanding ethic of energy conservation will be able to motivate significant changes in the current lifestyles of Americans.

The relatively high levels of opposition to the location of conventional electrical generating plants within community areas demonstrates the continuing concern over the threats to health, property and neighborhood appearance posed by these facilities. This same opposition would be faced by modular, integrated components of ICES projects if they presented the same hazards and pollution characteristics as conventional systems. Even if ICES designs and components were accepted by residents of the new communities, there might still be strong opposition from surrounding neighborhoods who would not gain any of the benefits of the new systems. ICES projects should anticipate community opposition to the integration of utility components and work to dispel the fear of pollution and health hazards.

The apparently favorable attitudes toward the development and installation of solar components are an encouragement to the ICES program. Although the program may not be based primarily on solar technologies, the projects are likely to integrate some solar energy components. Moreover, the public attitudes toward solar energy may be indicative of a willingness to adopt other new technologies that can be demonstrated to be clean, reliable and relatively resource efficient. In brief, public attitudes toward energy resources and conservation measures do not make the acceptance of ICES designs and components certain; yet, there is also no evidence to suggest insurmountable obstacles among consumers or the public at large. ICES should recognize the limitations of its appeal and work to overcome potential opposition in troublesome areas.

D.5 SUMMARY: FACTORS THAT INFLUENCE CONSUMER RESPONSE TO INTEGRATED COMMUNITY ENERGY SYSTEMS

This appendix has examined evidence on consumer evaluations and public attitudes regarding housing alternatives, community designs, and residential energy usage. The potential consumer response to ICES designs and components was analyzed by drawing parallels between these available materials and certain presumed characteristics of ICES alternatives. An examination of the projected consumer responses, in turn, was one means of estimating the potential for ICES commercialization.

The resulting prognosis is noticeably less optimistic than the assessment offered in the Oak Ridge MIUS report of 1974. It cannot be assumed that the philosophy of a planned community is an eminently popular attraction in today's housing market, that current community designs and utility systems can be re-arranged without encountering public resistance, or that an expanding ethic of energy conservation will lead American society to embrace ICES alternatives without hesitation.

This research has uncovered a number of potential factors that might hinder acceptance of ICES designs and components by consumers in the housing market. These factors can be briefly restated:

1. The concept of a highly planned community has a limited appeal and biased diffusion within American society. Planned communities tend to be more attractive to Americans with relatively high levels of education, who have predominantly white collar employment, and who have much higher than average incomes. Planned communities appeal to housing consumers who desire well developed community amenities. Conversely, less-planned communities tend to attract residents who place higher value on privacy, independence, and closeness to nature.

2. In general, high residential densities are viewed as an undesirable characteristic of communities. This is so partly because of the common association between high densities and other unattractive community features. To overcome this association, high-density housing developments must incorporate an unusual set of amenities. Only the more highly planned communities appear to be relatively receptive to higher density levels.

3. Consumer decisions in the housing market do not give high priority to the energy-related components and consumption characteristics of buildings. If higher initial investments are required for more energy-efficient designs

and utility systems, these will not be attractive to consumers and lending agencies who do not calculate usage and lifecycle costs.

4. Unconventional utility systems and components integrated into community environments and involving high levels of community interdependence and organizational interaction could involve adjustments in current lifestyles and public attitudes. The dominant public attitude toward the provision of utility services is that they should not in any way impinge on community life, appearance, or convenience. The integration of utility components into communities might include both adjustments in the physical arrangement of neighborhoods and a new set of community-oriented attitudes toward the provision of necessary services.

5. ICES projects could be opposed by a variety of indirectly affected community interest groups, as for example, environmentalists who might severely question the safety features and the potential for pollution of ICES. Neighboring residential groups who would not share in the benefits of ICES projects, might oppose construction within the community environment. Federal funds or guarantees necessary to finance ICES projects might require the implementation of various social goals, such as mixed-income housing, that could hinder community acceptance. Opposition in these areas of potential conflict would diminish the commercial potential of ICES projects. Prolonged and bitter debates in the process of local community review of construction plans would adversely affect the consumer response.

The conclusion reached in this examination of the relevant materials on consumer decisions and public attitudes is that the consumer response to ICES projects will be neither unhesitating acceptance nor blanket rejection. There is no basis to assume that American society will enthusiastically embrace highly planned community developments and energy-conserving changes in current lifestyles. However, neither is there any need to assume that Americans are unwilling to change, that they would reject these alternatives, or that they are unconcerned with the growing need to conserve energy resources. As pointed out earlier, it is unrealistic to base the expectations for the ICES program on the public's willingness to undertake completely voluntary changes in lifestyles. Encouraging certain incremental changes in housing patterns and public attitudes must be seen as part of the task of the program. The ICES program cannot be viewed as one of purely technological

innovation. It must be seen also as a program for possible social change in connection with the slow diffusion of new technologies. This means that the commercial success of the program will be influenced by its ability to encourage appropriate changes in American society while maintaining the present quality of life.

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- Report #15 Westlake Village, California
Report #16 Retirement Communities
Report #17 Comparison of Thirteen Non-Federally Assisted New Communities and Thirteen Control Communities
Report #18 Young Adults in Thirteen Non-Federally Assisted New Communities and Thirteen Control Communities
Report #19 Subsidized Housing Residents in Five New Communities and Two Suburban Control Communities
Report #20 Black Residents in Five New Communities and Two Suburban Control Communities
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APPENDIX E

A PROCESS FOR MANAGING INSTITUTIONAL FACTORS

The Community Energy Systems Commercialization Project
Argonne National Laboratory

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APPENDIX E
A PROCESS FOR MANAGING INSTITUTIONAL FACTORS

E.1 INTRODUCTION

The term, "institutional factors", has been adopted as a shorthand expression for all possible difficulties of the types outlined in this appendix. It should be acknowledged, however, that institutional characteristics might be found that are especially favorable (rather than unfavorable) for the development of energy-conserving communities. Wherever appropriate, these positive factors should be made part of strategies to enhance the overall prospects for community projects. What would seem to be useful at this point in the evolution of the commercialization element is the establishment of a process whereby institutional factors can be identified and strategies for resolving them can be generated, evaluated, and adopted. The object of this appendix is to suggest such a process.

As our study of institutional factors proceeded, it became apparent that it could not advance beyond an inferential level without community design and energy system proposals that are sufficiently detailed to evoke pointed comments from institutional representatives. Unfortunately, in the early stages of the Community Systems Program, design concepts had not yet been translated into the kind of specific example communities required. In the case studies of alternative energy systems for a suburban shopping center, however, we now are approaching the capability of proposing fully detailed, realistic examples of the subject communities for this program. Evaluations of future case studies should include coverage of potentially important institutional factors. Building on the kind of background studies prepared for the present project, the process suggested below might be applied for evaluations of institutional factors in case studies and, eventually, for analysis and management of factors in actual development projects.

E.2 ORIENTATION

The ultimate goal of the Community Systems Program is to help communities become more energy conserving. A basic assumption of the program is that integrated design of the community and its energy supply systems can identify potentials for energy conservation. The construction of energy-conserving communities might be opposed and impeded, however, by existing forces and institutions, acting in accordance with their own current objectives and

decision-making criteria. It will be necessary to understand the reasons for these possible hindrances and, where appropriate, to develop ways of neutralizing or reversing them. Accordingly, a major program goal of the commercialization element is to develop a comprehensive plan for dealing with institutional impediments.

It is probably inevitable that a goal of energy conservation, which has widespread acceptance in principle, will meet with conflicts in implementation. An obvious reason is the multiplicity of societal goals, all of which are desirable, but which often appear to be difficult to accomplish simultaneously. Some pairs of goals may be inherently incompatible; while in other cases, limited resources are at the heart of the apparent conflicts. Beyond general goal conflicts, however, others arise as a result of implementation specifics. Differences can arise because of: (1) differing goals or criteria applied by participants in the decision-making process, (2) contrasting scales of reference that might be applied in judging a project (i.e., the conflicts between the "greater public good" and the local impacts associated with a project), and (3) differing levels of awareness of the full implications of the proposed implementation. In the first instance, various institutional agents have objectives which, if not in actual conflict, are unlikely to be optimally matched for facilitation the implementation of energy conservation. Even if the goal of energy conservation were of paramount importance to all segments of society, developers, public officials, lending institutions, the building trades, and all others with an interest would each view a specific proposed policy or community project differently. The community projects through which the overall public interest in energy conservation is to be realized in the Community Systems Program are large-scale by developmental practice standards, but will tend to have primary, non-energy-related impacts over a relatively restricted local area. The project might seem less attractive under local evaluation than its energy consequences alone or even a balance of multiple consequences in a larger segment of society might indicate. Clashes between decision-maker roles and between various scales of evaluation are common in large-scale projects. Methods for resolving these conflicts have been the subject of past research efforts and might be incorporated into public practice directed toward energy conservation. In other cases, difficulties might arise simply because the various participants are inadequately informed of the project or its consequences to make compe-

tent and timely judgements about it. Although every project will have some uncertainty attending it, every effort should be made: (1) to understand the project and the institutional environment within which it will be developed, and (2) to make that information widely available.

It will be necessary to deal with several levels of abstraction as the commercialization element proceeds. In the study of institutional factors, in particular, one can imagine at least three levels of investigation. At the most abstract level, an initial survey of the total institutional environment for community systems projects is needed to establish a conceptual framework that will guide further detailed studies and will identify the factor areas (i.e., institutional sectors) that demand first attention in preparing the market for community systems. Other appendixes of this report contain the results of such an initial examination of the institutional environment. At a more detailed level of analysis, but still preceding real project proposals, the important institutional sectors previously identified will be examined more closely to develop and evaluate strategies for overcoming the negative factors within these sectors. Prototypical community systems projects will be a prerequisite for evaluating strategies. These strategies will have been implemented or will be available for implementation at the time specific demonstration projects are proposed. Evaluations of demonstration proposals will constitute the most detailed level of analysis of institutional factors in response to the full range of characteristics of a community systems project. In fact, the demonstrations will involve full-fledged development planning with all the attendant requirements to resolve contending evaluations of them.

To encompass activities ranging from initial overviews to the analysis of the institutional context for a specific demonstration project, the planning process that will be described is general and requires elaboration to meet the needs of different applications. The process diagrammed in Figure E.1 should be adaptable to the various uses within the commercialization element. Before discussing this process, however, several general concepts behind it will be briefly described.

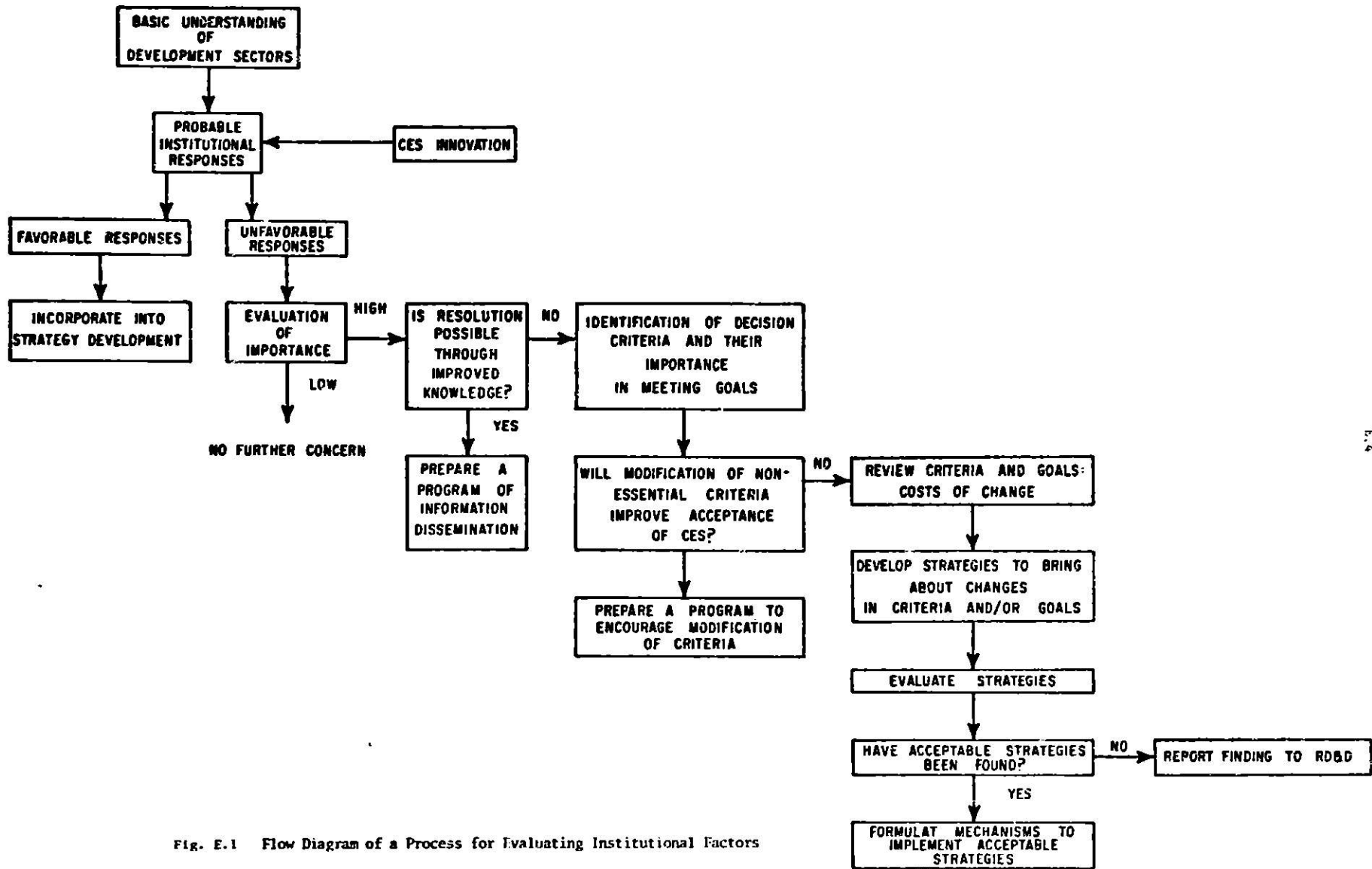


Fig. E.1 Flow Diagram of a Process for Evaluating Institutional Factors

E.3 EVALUATION PROCESS CONCEPTS

E.3.1 Crucial Sector Studies

The term, "crucial sector studies," summarizes the examination of institutional sectors with a goal of developing strategies -- sets of alternative policies and circumstances -- under which the institutional responses are likely to be more favorable. A basic understanding of what is usually involved in developing large-scale community projects is assumed in any examination of institutional factors, and an overview of this development process is provided in Appendix A. The institutional sectors that participate in the development process are covered in section 2.2.1; it should be clear that the customary objectives and decision rules within a sector (as represented, for example, by the lending policies of mortgage banking institutions) determine the responses that will be evoked by a community systems proposal. When only general concepts of energy-conserving community systems are known, the probable responses of well understood organizations can only be suggested. It might be necessary to augment and/or consolidate available information about some organizations before even this kind of generalization can be made. Although these generalizations are imprecise, they are sufficient to: (1) provide a sense of the institutional factors that might be anticipated, and (2) perform some initial judgment about their relative importance. The present study has this kind of initial ranking as its primary objective.

For those institutional sectors, judged to be more crucial in the commercialization of community systems projects, more intensive examination is necessary. Organizations within this category will be those whose approval is essential for the success of a community systems project, but which might be in serious doubt under many anticipated circumstances.

E.3.2 Strategy Evaluations

"Strategy evaluations" will be taken here to mean the proposal and analysis of ways to solve a recognized problem or achieve an agreed upon goal. The crucial sector studies will form the knowledge base from which it will be easier to formulate concise problem statements and suggest strategies for their solution. Many of the evaluation methods and techniques that have been developed for policy analysis¹ and for impact studies of large-scale development projects will be useful in community systems evaluations.

Whether the evaluations are strictly quantitative or use methods that also explicitly utilize judgement and intuition, it will be nearly impossible to propose and carry out meaningful evaluations of strategies related to community systems *concepts*. As mentioned in the previous section, responses to the concepts are only suggestions of what they might be for concrete proposals. A concise problem statement is predicated on highly probable institutional responses to detailed, realistic proposals. Thus, the evaluations envisioned here assume the existence of one or more hypothetical or actual demonstration project proposals. In other words, it is felt that an in-depth analysis of institutional factors must proceed from an examination of specific cases.

In the best planning tradition, several alternative strategies should be nominated for overcoming the problem under investigation. Many potential strategies will have been turned up in the crucial sector studies, but no reasonable source of ideas for strategies should be overlooked. A strategy might involve nothing more than a program of information dissemination. If the problem is caused by more than poor understanding of the proposal and its circumstances, however, other strategies, appropriate for the situation, will be required. Strategies might be made up of public and private policies and actions. Taxation policies, regulations, and public investments could be included. Some public strategies, such as large investments in physical facilities and their geographical distribution or environmental policy, might be more appropriate for the federal government. Land holding, as a public strategy, and regulation of utilities could fall within state governmental responsibility; whereas, other strategies, such as land-use regulation, traditionally have been delegated to local governments. Private strategies with regard to ownership of the development project, mechanisms to encourage life-cycle costing through lending criteria, and training programs for construction workers and systems operators could be considered. Some actions by professional societies, trade unions, trade organizations, and citizens groups also could conceivably be viable strategies. The strategies actually selected for evaluation as solutions to a particular problem might be decided on with the assistance of experienced practitioners who are intuitively able to judge which strategies have the greater chance for success.

Although the logical mode of operation would seem to be the proposal and evaluation of strategies as solutions to specific problems, the same

analysis procedures would apply if the objective were to rigorously examine a particular strategy, instead. Then the process would be to construct representative test problems and alternative strategy sets whose effectiveness in solving the problems and prospects for implementation could be compared with those of the original strategy.

Evaluation methods basically involve a determination of the impacts of a strategy and the comparison of those impacts against some standards or against similar impacts from alternative strategies. At a later stage of the Community Systems Program, the same evaluation methods could be applied to compare alternative demonstration project proposals. Several categories of evaluation, related to the effects or impacts of the strategy or project proposals, exist. Examples in the planning literature related to urban development² include technological and fiscal feasibility, distributional effects, resource conservation, flexibility under changing conditions, levels of service and system performance, economic efficiency, spatial and institutional arrangement and operation of metropolitan facility-service systems, and generalized spatial and social accessibility. Not all of these categories will be equally appropriate for evaluation of the various proposals, and under some circumstances, others may be added to the list.

The methods for carrying out these evaluations can range from approaches that attempt to quantify all impacts on a common scale (often dollars) to interactive and participatory approaches that attempt to make explicit the essential differences between contending view points, resolve them to the degree possible and assess the resulting costs (and benefits) to each affected group. Cost-benefit, cost-revenue, and cost-effectiveness represent well established techniques that stress quantitative analysis of impacts. Quantitative methods under development seek to evaluate simultaneously alternatives for several evaluation categories; although these methods have been primarily applied to traditional land-use planning, adaptation to the evaluation of strategy and development proposals should be possible. In contrast, there is another body of evaluations that stresses the importance of the process of defining the problem and seeking its solution with the participation of affected groups. Representative of this latter group are Delphi techniques and computerized interactive and gaming techniques.

The distinction between quantitative evaluation techniques and more

broadly defined evaluation processes has been drawn by Hudson, Wachs, and Schofer in terms of the relative complexity of appropriate applications for each:

"The more clear-cut the nature of the planning problem and the narrower the range of impacts to be considered in plan implementation, the more dominant can be the application of techniques. An example might be a financial investment analysis. The more complicated and unstructured the problem, however, and the greater the disparity among participants in their perceptions of the system's objectives and impacts, the more techniques recede in importance, and become adjuncts to the "process" aspect of evaluation. An example of this might be an organizational development strategy."³

If these comments are interpreted in light of commercialization's "planning problems" of developing strategies for reducing institutional factors and evaluating proposals for demonstration projects, it is evident that both broadly-defined, problem-sharpening evaluation processes and their narrower adjuncts -- quantitative evaluation techniques -- will have a place in the program.

E.3.3 Strategy Adoption

Whatever the outcome of the strategy evaluations, they can have an effect on energy consumption in communities only insofar as they influence public and private policies and decision-making. From the outset, the Community Systems Program has emphasized the importance of an effective transfer of technology -- be it hardware or ideas and techniques -- to accomplish its goal of demonstrable and continuing community energy conservation. The very existence of a commercialization element in the program is evidence of this concern. Representatives of the groups who ultimately must make the implementation decisions have participated in all elements of the program as advisors and consultants. The comments here merely reiterate the necessity of maintaining a sensitivity to the problems that user groups will have in assimilating new information and adopting changes. This sensitivity should be a separate strategy evaluation category -- institutional feasibility -- which can be judged most reliably by the user-group representatives. A closely related item that must be considered throughout the program is the choice of formats and mechanisms for disseminating evaluation results and encouraging actions toward conservation.

E.3.4 Community Development

The follow-through of the Community Systems Program might be to provide continuing services in support of community systems planning and implementation as an integral part of community development throughout the country. The kind of analysis of institutional factors and the process for their resolution that are outlined here will be at least an implicit part of the planning for each of these projects. Rather than "preparing the market," the objective will then be to gain significant energy conservation under the conditions presented at a specific site, including the local institutional context. Community systems demonstration projects should, therefore, include tests of institutional impact and conflict management methodologies that would become a part of the set of technologies that are made available for general application. Many of the methods that will have been applied in strategy development and evaluation within the commercialization element will also be applicable (and probably are already in use) to local project evaluations.

E.4 GENERALIZED PROCESS

Referring again to Figure E.1, we see that it represents a process that combines Community Systems Project scenarios with knowledge about the institutional sectors having some control over the development process to predict likely responses to the projects. The more important of these responses are to be subjected to closer analysis in which a determination is first made about whether greater availability of information, including that about energy systems design, energy conserving site planning, energy-sensitive local governmental policies and decision-making, and organization patterns to reduce financial risk, can lessen the anticipated negative impacts. (The emphasis is still on institutional factors -- the impeding responses. Positive responses should be noted also and used for strategies to improve the situation.) It is assumed that important factors that are not simply a matter of poor information may arise from conflicts between some aspect of a project scenario and the decision-making criteria of the responding organization. If the criteria are not central to the functioning of the organization, it might be relatively easy to make changes that will benefit the project without interfering with other organizational responsibilities. One example is in building code enforcement where the objective of protecting public health and safety can be served

just as well through performance codes that could be more favorable to energy-related innovations as through the currently wide-spread specification codes.

In a sense, the analysis described is preliminary to the fundamental problems that represent real conflicts among some organizational responsibilities and the proposed community systems projects. Hopefully, significant improvements in community energy use can be achieved without embarking on a program to examine the possibilities for organizational and policy changes that are implied by the column of activities indicated on the right side of Figure E.1. The steps of strategy development and evaluation included in that column also will be part of any effort in information dissemination or discovering ways of accommodating community systems projects within current organization decision-making. For those projects that do not allow simpler solutions, choices must be made between changing the projects or some currently operating objectives. These political choices will require extensive use of the participatory evaluation processes. Until appreciably more examination of realistic community systems scenarios has been accomplished, it is impossible to predict whether these choices will have to be made.

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