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Economic Objectives of Utility Companies and Developers in Evaluating a MIUS

Brit Jeffrey Bartter

Building Economics Section, 463.02
Technical Evaluation and Application Division
Center for Building Technology
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Washington, D. C. 20234

November, 1975

Final Report

Prepared for
Division of Energy, Building Technology and Standards
Office of Policy Development and Research
Department of Housing and Urban Development
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MODULAR INTEGRATED UTILITY SYSTEMS
improving community utility services by supplying electricity, heating, cooling, and water/ processing liquid and solid wastes/ conserving energy and natural resources/ minimizing environmental impact

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U.S. DEPARTMENT OF COMMERCE, Rogers C.B. Morton, ***Secretary***
James A. Baker, III, ***Under Secretary***
Dr. Betsy Ancker-Johnson, ***Assistant Secretary for Science and Technology***

NATIONAL BUREAU OF STANDARDS, Ernest Ambler, ***Acting Director***

Preface

This report was sponsored by the Department of Housing and Urban Development (HUD) under the Modular Integrated Utility Systems (MIUS) Program, and it was administered by the MIUS team at the National Bureau of Standards (NBS). Dr. Harold E. Marshall, Section Chief, Building Economics Section, NBS, provided the immediate supervision and guidance to the author. In addition, both Dr. Marshall and Mr. John Ryan, Assistant Project Manager of the NBS-HUD-MIUS Team, assisted with valuable suggestions and criticisms during the research and review phases of this report. A complete draft was prepared by Mr. Bartter before his departure from NBS in 1973. Mr. Joel Levy of the Building Economics Section and Mr. Steve Webber of the Office for Energy Conservation handled the final writing and editing of the paper in the author's absence. Special thanks must be given to the persons listed in Appendix B, without whose generous time and information this report could not have been written. Finally, recognition is due to the secretaries of the Building Economics Section for their patient and conscientious typing during several drafts of this report and other members of the Building Economics Section for technical reviews.

The Department of Housing and Urban Development (HUD) is conducting the Modular Integrated Utility System (MIUS) Program devoted to development and demonstration of the technical, economic, and institutional advantages of integrating the systems for providing all or several of the utility services for a community. The utility services include electric power, heating and cooling, potable water, liquid waste treatment, and solid waste management. The objective of the MIUS concept is to provide the desired utility services consistent with reduced use of critical natural resources, protection of the environment, and minimized cost. The program goal is to foster, by effective development and demonstration, early implementation of the integrated utility system concept by the organization, private or public, selected by a given community to provide its utilities.

Under HUD direction several agencies are participating in the HUD-MIUS Program including the Energy Research and Development Administration, the Department of Defense, the Department of Health, Education and Welfare, the Environmental Protection Agency, the National Aeronautics and Space Administration, and the National Bureau of Standards. The National Academy of Engineering has provided an independent assessment of the Program.

This publication is one of a series developed under the HUD-MIUS Program and is intended to further a particular aspect of the program goals.

Drafts of technical documents are reviewed by the agencies participating in the HUD-MIUS program. Comments are assembled by one of the agencies into a Coordinated Technical Review. The draft of this publication received such a review and all comments were resolved with HUD.

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EXECUTIVE SUMMARY

This report provides information from an initial investigation to the Department of Housing and Urban Development-Modular Integrated Utility System (HUD-MIUS) program about the economic decision-making process for implementation of a MIUS by utility companies, developers, and a combination of these two groups.

Five participants and three roles are identified. The private utility company, the public utility company, the private speculative developer, the private non-speculative developer, and the governmental developer are the participants; and the initiator, owner and operator, and ultimate consumer are the roles they might play.

Information was obtained through informal telephone interviews from these participant groups about their economic analysis of utility investment alternatives. The content of these conversations was synthesized into economic criteria (see Table 2.3) which are perceived by each participant to be most important in evaluating alternative utility investments. From the analysis of these economic criteria and without reference to any legal barriers, the possible combinations of participants and roles in the implementation of a MIUS are specified. These combinations are ranked, according to the degree of likelihood that each method will actually be employed, in Table 2.5.

The conclusions of the interviewer were that MIUS is most likely to be implemented by a governmental body, such as a municipal utility or governmental developer. It seemed to the interviewer less likely that MIUS would achieve market acceptance and implementation in the private sector given the existing institutional structure and no special incentive supplied by the government.

1. INTRODUCTION

This project is intended as a preliminary analysis of the decision-making criteria that utility companies and developers might use in an economic evaluation of a Modular Integrated Utility System (MIUS) project. The MIUS program is sponsored by the Department of Housing and Urban Development (HUD) and is designed to provide improved community utility services. The MIUS system integrates into a single facility the essential utility services of electric power, space heating and cooling, potable water, and liquid/solid waste treatment. Other agencies cooperating with HUD in the program are the Energy Research and Development Administration (ERDA), the Environmental Protection Agency (EPA), the National Aeronautics and Space Administration (NASA), Department of Defense (DOD), Department of Interior (DOI), Department of Health, Education, and Welfare (HEW) and the National Bureau of Standards (NBS). The National Academy of Engineering (NAE), under contract to HUD, has established the Integrated Utility Systems Board (IUSB) to provide an independent assessment of the program.

The scope of this study is relatively narrow. For example, neither technological nor legal barriers are discussed, both of which could be important in the adoption and implementation of a MIUS. Its purpose is to provide a perspective to the officials at HUD responsible for implementation of the MIUS program that will give them a view of the effect on entry into the program of the economic interest of potential participants in MIUS, like utility companies and developers.

Chapter 2 is divided into five sections. Section 2.1 gives a brief description of the research method used to obtain information. The identification of the participants and their roles in a MIUS evaluation and implementation are explained in Section 2.2. Sections 2.3 and 2.4 give a brief review of the overall operating philosophies and specific economic criteria used by the utility companies and the developers respectively. Section 2.5 uses the information presented in this study to determine the most likely method of implementation for a MIUS. Chapter 3 provides conclusions and makes suggestions for further research.

Appendix A describes graphically and verbally how the prices of utility services vary under changing demand and supply conditions. Appendix B lists the interviewees who contributed the information for this report, and Appendix C describes a flow chart that gives a starting point for additional study of the economic and non-economic decision processes affecting the implementation of a MIUS.

2. ECONOMIC OBJECTIVES OF UTILITY COMPANIES AND DEVELOPERS

2.1 Research Methodology

Informal oral interviews by telephone and by direct contact were the research techniques used in this study. No reference is made to individual conversations in the presentation of investigation results. Rather a synthesis of the opinions expressed in the interviews has been presented. (See Appendix B for a listing of the persons interviewed.)

The project progressed in the manner referred to by Coleman[1] as "snowball" research, so named because initial leads suggest additional sources of information. Thus a chain of contacts is generated. The principal bias of this method is that the information obtained is greatly influenced by the earliest contacts and their familiarity with the subject as well as their network of acquaintances and their implicit prejudices. However, an attempt is made to draw useful insights from the small sample of interviewees, and the spectrum of thought concerning the MIUS alternative which they present.

2.2 Clarification of Terminology

To discuss a MIUS alternative clearly and effectively, the participants and the roles they might play in a MIUS decision process should be identified. There are essentially five potential participants:

1. The private utility company (U_p),
2. The public (municipal) utility company (U_m),
3. The private (non-governmental) speculative developer (D_{ps}),
4. The private (non-governmental) non-speculative developer (D_{pns}), and
5. The public (governmental) non-speculative developer (D_g).

The private utility company (U_p) is considered to be an investor-owned electric power generation firm. It was initially assumed that since the private utility segment of the electric power industry accounted for 77% of the electricity produced in the United States, this group would be the best market for the MIUS alternative. As the interviews progressed, however, this view changed.

The public utility company (U_m) is a municipally-owned utility facility which may provide the community with water and sewage treatment, solid waste disposal, and in some cases electric power and/or steam. Table 2.1 shows the breakdown of electric generating capacity into private (investor-owned), public, federal, and cooperative power systems.

Developers are engaged in the development of some private and/or public projects.[2] They are faced with the need to purchase a source of one or several utility services from a utility company. Either conventional utilities may be

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[1]James S. Coleman, "Relational Analysis: The Study of Social Organizations with Survey Methods," Human Organizations, XVII (4, 1958) pp. 28-36. Also, George J. McCall and J.L. Simons, Editors, Issues in Participant Observation: A Text and Reader. (1969).

[2]Housing and non-housing developers are included.

TABLE 2.1

THE ELECTRIC POWER INDUSTRY[a]

1970

GENERATING SYSTEMS

	Private Investor-Owned	Public Non-Federal[c]	Federal[d]	Cooperative[e]
Number of Systems	250[b]	700[b,f]	2	65[b]
Megawatt Capacity	262,668	34,245	38,718	4,722
Annual Megawatt Hours	1,182,855,000	139,204,000	185,755,000	21,767,000
Percent of Nation's Power Generated	77	10.5	11.5	2
Percent of Nation's Customers Served	78	Not Available	Not Available	8

[a]Federal Power Commission, The 1970 Federal Power Survey Part I, (Washington, D.C. December 1971), p. I-1-11.

[b]Estimated.

[c]Municipally-owned generating facilities.

[d]The Tennessee Valley Authority and a system operated by the Department of the Interior comprise the Federal portion of the industry.

[e]The electric cooperatives primarily redistribute bulk power purchases to rural areas of the country.

[f]In addition, there are approximately 1400 municipal distribution systems which purchase bulk power for resale only.

used or negotiations may be initiated by either the utility or the developer to build an on-site or off-site MIUS plant. Failing that, some developers might undertake a MIUS on their own.

Developers can be classified in two ways. First, their legal operating status may be either non-governmental (private) or governmental (public). Second, their capital commitment to the development may be either speculative (investment-for-profit oriented) or non-speculative (owner-utilized and operated). Speculative projects tend to have short-term capital commitments with minimum initial costs and high rates of return. Non-speculative projects are characterized by the intent of the developer to use (in most cases occupy) and be responsible for the operation and maintenance of the project over the long run. Using these distinctions, a four-celled matrix of the types of developers and examples of developments can be made as shown in Table 2.2. The examples given do not exhaust the many types of developments. They are intended simply to give a perspective of the possibilities.

The three principal roles relative to a MIUS alternative which these participants may assume are:

1. The institutor of a MIUS.
2. The owner and operator of a MIUS.
3. The ultimate consumer of utility services provided by a MIUS.

The institutor is the organization which assumes the burden of obtaining the financing, selecting the site, choosing the builder, and integrating the available multi-utility expertise. In this role the participant is responsible for all of the technical, legal, and economic details which must be coordinated in order to bring a functioning MIUS plant into existence. The owner and operator is the person that assumes the day to day operations, maintenance, accounting, and decision-making associated with providing the three, four, or five utility services included in a MIUS. It is conceivable that the owner and the operator could be different participants, but this paper assumes they act as one. The ultimate consumers in the MIUS network are the users of the utility services.

2.3 The Utilities

Utility companies today are highly specialized, decentralized operations whose main interest is providing their utility service to meet their particular service demand and promote the growth of their firms. The companies are, for the most part, singular in function and it was the interviewer's impression based on the responses he received to his questions that they would be reluctant to undertake a business venture which, albeit in a utility service industry, is in reality quite foreign to them. Electric utilities know little about the solid waste collection and disposal business. Yet utilities can be expected to behave in a rational economic manner. If it can be demonstrated that a MIUS is compatible with their present objectives and that it will provide economic rewards, then they might be interested in considering it as an alternative to simply providing their single service with conventional techniques. This conclusion is valid for both private and public utilities, but differences in their philosophies and objectives do exist and will be noted when the specific economic criteria are discussed.

TABLE 2.2

TYPES OF DEVELOPERS

AND EXAMPLES OF DEVELOPMENTS

POTENTIALLY SUITABLE FOR

A MIUS

Legal Status		Capital Commitment	
		Speculative	Non-Speculative
	Non-Governmental (Private)	$(D_{ps})^a$ Apartment Complex New Town Shopping Center	$(D_{pns})^a$ University Research Complex Apartment Complex New Town Shopping Center Industrial Complex Tourist Complex Medical Complex
	Governmental (Public)	No Examples	$(D_g)^a$ Public Housing Military Complex State Institution (prison, university) Medical Complex Isolated Rural Community Municipality

[a]These symbols are defined at the beginning of Section 2.2.

The following discussion treats objectives of the utilities as they were explained to the author by practitioners in the field. Appendix A provides a more detailed explanation of the economic constraints on utilities and a theoretical discussion of the causes of changes in electric power prices over time.

Control is one of the objectives of private and public utilities. Control may be thought of as the jurisdictional authority of a utility company to provide a particular service to a specific region without direct competition. As long as none of this monopoly power is lost, MIUS may be attractive to the utilities. Control is lost if developers "go it alone" and construct, own, and operate an on-site MIUS independent of utility company involvement. Utilities might be expected to oppose self-sufficiency of developers for any utility service.

The economic criteria that comprise the objective function of utilities in evaluating alternative investments such as a MIUS are listed in Table 2.3. This table summarizes the principal economic factors in the MIUS decision process and matches them to those participants who give those factors significant consideration in their analysis.[1] Municipal utilities and governmental developers tend to regard the same set of criteria as relevant, and all of the private operators (U_p, D_{ps}, and D_{pns})[2] tend to regard a certain set as relevant. Several factors are also shown common to all participants. The remainder of this section will explain the criteria that pertain to private and public utilities, and Section 2.4 will discuss the criteria that pertain to each developer.

Throughout the economic evaluation of a MIUS in comparison to conventional utilities, it must be remembered that the comparisons should be made using aggregate data for up to five different utility systems against the data of a single MIUS.

The rate of return on an investment is defined as the discount rate which equates the present value of the stream of benefits to that of the stream of costs. Utilities are concerned that a MIUS meets their required or "hurdle" rate of return. Rate-of-return techniques do not always yield a unique rate of return. Despite this drawback, this method of evaluation is almost universally computed in investment analysis, and though no consensus was obtained among the utilities surveyed for this report, a range of 6-20% was found as the desired minimum rate of return.

Financial measures are important to utilities because they give an idea of the present financial position of the firm. Liquidity measures are computed to estimate the likelihood of the firm being able to meet its fixed obligations and its ability to generate cash. Once a firm has examined its present financial

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[1]It would seem that all participants would give consideration to practically all of the criteria, but an attempt has been made here to indicate those which the participants themselves in the interviews on which this report is based have pointed out to be most significant to them.

[2]These symbols are defined at the beginning of Section 2.2.

TABLE 2.3

SUMMARY OF ECONOMIC CRITERIA RELEVANT TO

EACH PARTICIPANT IN THE EVALUATION OF A MIUS

Criteria	U_p	U_m	D_{ps}	D_{pns}	D_g [a]
Rate of Return	x	x	x	x	x
Financial Measures	x	x	x	x	x
Life-Cycle Cost	x	x		x	x
Capital:					
Amount of Commitment	x	x	x	x	x
Duration of Commitment	x	x	x	x	x
Availability of Financing	x	x	x	x	x
Prevailing Interest Rates	x	x	x	x	x
Location and Nature of Development:					
Heat Balance	x	x	x	x	x
Size	x	x	x	x	x
Tax:					
Property	x		x	x	
Income	x		x	x	
Depreciation Schedule	x		x	x	
Investment Tax Credit	x		x	x	
Availability and Cost of Labor	x	x		x	x
Reliability	x	x		x	x
Development Lifetime	x	x		x	x
Environmental Quality Standards	x	x	x	x	x
Competitive Advantage	x		x	x	
Rate Structure	x	x	x	x	x
Security Prices:					
Stocks	x		x	x	
Bonds	x	x	x	x	
Installation Time			x		

[a] These symbols are defined at the beginning of Section 2.2.

status, it is then able to evaluate potential additional investments clearly in light of these facts. Although financial measures provide useful information, they are insufficient when used alone to judge the firm's ability to undertake new ventures.

Life-cycle costing of investment alternatives provides a very useful measure of comparison. With this technique all relevant cash outflows throughout the lifetime of the project, including initial investment costs, operation and maintenance costs, and replacement costs are computed and discounted by some appropriate discount rate to determine a present value. Present value techniques provide answers which contain a high level of information regarding the magnitude and timing of benefits and costs relevant to an investment. Utilities often use in their decision-making the rule of selecting the alternative with the lowest life-cycle cost. (Sometimes this is referred to in the industry as minimizing the revenue requirements.)

The financial climate can significantly influence the utilities willingness to implement a MIUS plan. The amount of the initial capital commitment and the availability of financing for the balance of the cost of each investment alternative are important economic criteria. Utilities, like most investors, seek to commit as little capital as possible.[1] In addition, financial institutions or investors in the market must be found that are willing to own (that is, supply the majority of the necessary capital for) each alternative investment, including a MIUS. Closely related to this is the interest rate (the cost of credit) and the duration of capital commitment. Tight credit may make certain investments impossible. The possible methods of financing available to private utilities are mortgages, stocks, and bonds. (Federal incentives may also be offered via financing assistance.)

Municipalities differ from private companies in that bonds offer municipalities financing at a much lower cost than the methods available to private utilities. Through the issue of long-term, tax-exempt bonds, municipal utilities have a powerful instrument for financing.

The location and nature of a development involve considerations with significant economic impact that should be taken into account in a decision whether or not to select a given MIUS alternative. For example, the location and nature will often determine whether a development satisfies the requirements of a proper heat balance. Heat balance here refers to the amount of heat needed for space heating and air-conditioning relative to the amount available as a recovered by-product from electrical generation. Many commercial and industrial plant operations have a more uniform heat requirement than do residential developments. Hence, the inclusion of building areas for commercial application in a MIUS development would decrease the importance of the seasonal considerations related to heat balance.

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[1]The relation of the perceptions of the persons interviewed, which are reported here, to the Averch-Johnson argument that under certain conditions a firm in an industry where rates of return are regulated will overinvest in capital in order to increase its allowed returns is not pursued here. A considerable literature has developed on the subject since the appearance of H. Averch and L.L. Johnson "Behavior of the Firm Under Regulatory Constraint," American Economic Review, Vol. 52 No. 5 (December 1962), pp. 1052-69.

The nature of customers' needs and the degree of flexibility required by foreseeable changes in needs of the development is another important consideration. Developments which most closely approach having a known constant demand for utility services seem best suited for a MIUS system independent of utility grids.

Another important consideration with direct economic implications is the size of a MIUS installation. The necessary size for economies of scale should be computed for each of the utility services offered in a MIUS package. Megawatt generating capacity and British Thermal Unit heat demand are often used as the measurement units in size determination. Discussions which the author had with persons in utility companies suggest that a capacity from 15 to 20 megawatts was the minimum size for an economically feasible MIUS, and the complete range of possible plant sizes went from 3 to 300 megawatts. No data were recorded for the necessary British Thermal Unit demand. It is though that a MIUS plant of optimal size requires the use of fossil fuels. Therefore, one consideration is to have the development near or have available for it a source of clean-burning fossil fuel at a reasonable cost.

If the development has no conventional utility systems available (e.g., a new town or an isolated area) a MIUS may be ideal to meet the needs of that development. On the other hand, if a development (e.g., an established city) already has an operating utility infrastructure, this would probably result in the utility company's decision against a MIUS due to the possibly prohibitive costs of redoing the distribution system.

If utilities services are unavailable for institutional reasons, (a local sewer moratorium) then the utility company might be biased toward providing a MIUS plant.

There are several tax considerations of importance to utilities in considering investments. Private utilities are particularly interested in property taxes, income taxes, gross receipts taxes, depreciation, and investment tax credits. Property tax rates are established by the local government in which the utility operates and can vary depending on the type of facility that is built, and where it is built within the region of local jurisdiction. Income taxes are levied by the state and Federal governments, and they consume 50-60% of utility profits (before tax).

Depreciation plays a significant role in determining the willingness of utilities to invest in new facilities due to the implicit tax savings. The depreciable life of a project and the rate of acceleration of the schedule used are important economic criteria.

The investment tax credit law allows utility companies a 4% credit[1] on their state and Federal income tax for equipment purchased with an expected life greater than 7 years. This forgiveness applies only to the plant and equipment and not to the land or peripheral buildings. If legislators determined that the MIUS alternative would enhance the national welfare, they could bias investment toward MIUS by increasing the investment tax credit for MIUS relative to other utility systems, and thereby subsidize MIUS.

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[1]Non-utility companies get 7 or 8% investment tax credits.

Public utilities are not concerned about taxes in their decision-making except as to how their decisions affect the tax rates of local taxpayers. They also implicitly include tax considerations in their analysis by their inherent ability to finance through tax-exempt bonds.

The availability and cost of labor for the operation of a multi-utility plant must be considered. Since MIUS is a new approach to the utility business, most operators, both engineers and semi-skilled technicians, will initially be taken from specialized operations. There will be some costs involved in using persons not familiar with all of the utilities included in a MIUS and with how they coordinate as a single operation. In addition, the negotiations that may be required with organized labor, both within the plant and within the industry as a whole, to secure contracts that will permit their members to transcend utility service boundaries could be prolonged and costly. Perhaps, in the long run, a new labor union would be formed for integrated utility system employees.

The lack of reliability is based on engineering technology but has potential economic costs. Since the MIUS is a new and complex system, when it is installed the utility may have to undertake debugging expenses in excess of those associated with a conventional facility. Repairs may be difficult to make and costly. With a MIUS the expense of emergency backup services tied into conventional service systems must be considered. Conventional utilities might try to overprice these backup services to reduce the competition from MIUS.

The lifetime of the development project concerns utility companies. Since a MIUS is not a present transportable, its economic feasibility depends to a large extent on the time period over which possible cost savings can be realized. For this reason utilities must be certain that the development will be operated for many years. Utilities are wary, because if a MIUS is installed in a housing development that fails, the company that builds and operates the MIUS suffers a loss.

The implications of environmental quality standards have economic significance in evaluating investment alternatives. If a MIUS can meet the regulations of the Environmental Protection Agency at less cost than the aggregate cost of bringing conventional utilities into compliance, then it may be an attractive alternative. The potential benefits and costs to society of a MIUS should be compared with those of a conventional system. Stringent Federal pollution regulations might encourgage utility companies to build MIUS plants, assuming they operate with less harmful wastes than alternative plants.

Private utility companies could be interested in a MIUS if it provided competitive advantage over conventional methods. If from its cost savings, energy savings, responsiveness to environmental standards, or simply its uniqueness, a MIUS could bring new revenues to the company, it would be considered as an alternative. Perhaps a utility company that pursued the implementation of MIUS approaches to utility services as a corporate policy could open up a new market and increase th growth rate of the firm.

Changes in rate structure are important to utility companies. As demand increases for utility services and the rates for these services go up, a MIUS may offer smaller increases or even decreases in rates to those developers who receive integrated utility plants. Thus utility companies under these conditions might be biased toward the MIUS alternative. Otherwise, developers might decide to undertake a MIUS independent of the utility companies.

The market prices of stocks and bonds are normally important to a private firm. But since utilities are regulated monopolies, they have little control over their profit rates, and therefore little control over the market price of their securities. Only if management is seriously negligent does it appear that corporate decisions significantly affect stock and bond prices. Otherwise, these prices are primarily determined by regulatory actions specifically directed at setting the permissible rate of return to shareholders and debtholders.

These are the major economic criteria that utility companies examine when evaluating a MIUS against a conventional utility system. Next, the developer's criteria will be discussed.

2.4 The Developers

Three types of developers were identified in Section 2.2. In the private sector of the economy were both speculative (D_{ps}) and non-speculative (D_{pns}) developers. In addition, there was the governmental developer (D_g). Each of these types differs from the other in their economic objectives. Therefore, this section will be organized by developer types to highlight their differences in philosophy and economic criteria for decision-making.

Speculative developers are primarily concerned with getting a quick return on their investment in the specific development they are promoting. They are not in the utility business, and they are not interested in diffusing their energies and resources on utilities. Table 2.3 indicates that speculative developers are concerned only with economic criteria that affect their short-run[1] involvement in the development project. Thus life-cycle costing of a possible MIUS investment is less important than the rate of return, the amount and duration of capital commitment, and any possible benefits or costs due to taxation. It appears that speculative developers seek to minimize the first cost of an investment, maximize their short-term return (at least 25% per annum), and to skim some excess money out of the financing package to create some instant cash.[2] With respect to taxation, incentives must be present for short-run benefits. For example, accelerated depreciation, property tax deductions from the utility system on-site, or investment tax credit at the non-utility rate of 7 - 8% could be incentives for the developer to provide utility services.

A proper heat balance is necessary, and the MIUS plant size must meet the needs of the development. No concern was expressed for the availability and cost of trained labor or for the long-run reliability of the system. (It is recognized that this might be the result of a bias in the interview technique). Environmental quality effects are dealt with only as absolutely

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[1]Short-run in this study is considered from 5 to 7 years.

[2]This is done by building the development at a cost below the amount of financing obtained, thereby creating a surplus that may be used to invest in another project.

required by the Environmental Protection Agency. Otherwise, little attention seems to be given to the national energy conservation objectives that MIUS may help to meet.[1]

Speculative developers would be interested in a MIUS in some special circumstances where a utility moratorium prevents them from pursuing their project. For example, if Montgomery Village, a new town in Maryland, had a MIUS plant that would meet the demands of the projected finished town, the developers would not be prevented from completing the town as they are today because of a county sewer moratorium[2]. Commercial considerations are also important. If a MIUS can offer the users of the development better, cheaper, or more reliable utility services than conventional systems, then speculative developers would be interested in these added marketable features. Aesthetics are important, and therefore, an on-site MIUS plant would be desirable only if it were carefully designed and placed to be as unobtrusive as possible. Finally, a major consideration among speculative developers is the time lag involved in getting utility services installed. If a MIUS requires a longer time to become fully operational for a development than connecting with conventional systems, then the speculative developers may not be willing to absorb the additional delay.

In summary, speculative developers will be reluctant to adopt a MIUS with their limited resources and against the wishes of utility companies unless good quality, guaranteed, reasonably priced services are not already available locally. To be attractive, a MIUS must provide utility services that are quicker, cheaper, and less risky than services provided by conventional alternatives.

Private, non-speculative developers (D_{pns}) exhibit the economic objectives of a typical firm in perfect competition.[3] Their analysis of alternative investments, such as a MIUS against a conventional utility, will reflect their underlying primary objective of maximizing long-term profits.

Financial analysis is pursued in a more sophisticated manner than for either private speculative or governmental developers due to the inherent pressures of competitive operations. Life-cycle costing of all the relevant cash flows, the rate of return, and several financial measures are calculated and compared. Capital considerations are evaluated by studying the amount of capital required, the duration of its commitment, and the availability and cost of financing. Because tax effects play a significant role in evaluating investments, property and income taxes, depreciation schedules, and investment tax credits are carefully investigated.

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[1]Note that the interviews on which this study is based were conducted in 1973. It is quite possible that more attention is given energy-conservation measures in 1975.

[2]The Montgomery County Sentinel, Vol. 118, No. 49, Mongomery County, Maryland, in its Upper County Edition of Thursday, August 2, 1973, (P. 1 c. 1) quotes Bill Hurley, Vice-President of Kettler Brothers, Inc., the developers of the new town of Montgomery Village as saying "Montgomery Village will be 10,000 people short of its original 30,000 population projection...Sewage is our biggest headache."

[3]Perfect competition implies that the firm cannot by its independent actions affect the market price of its product. Such a firm can sell all of its product that it wishes at the established market price.

The location and nature of the development will be evaluated against the size and heat balance specifications of a MIUS. The availability and cost of personnel to operate an on-site utility plant is important. Reliability, too, may be very significant for competitive firms. The costs of utility system failures are particularly high for owner-occupied, non-speculative developers. The development, though non-speculative, may not have a planned lifetime long enough to warrant a MIUS in which case the purchase of utility services from conventional systems would be favored. Environmental quality effects are important, particularly if a MIUS can incorporate the treatment of recycling of some otherwise polluting waste from the development's operation (for example, excess heat or contaminated liquids or solids). Private, non-speculative developers tend to use better quality materials in construction, and since they own and occupy the development they might be expected to be more responsible in operating and maintaining an on-site utility facility.

In summary, private, non-speculative developers will ultimately base their comparison of a MIUS with a conventional utility system on long-term profits to the firm. Given the increasing rate trend in the utility industry and the suitability of many non-speculative developments for a MIUS, it seems likely that developers might select a MIUS to fulfill their utility needs.

Governmental developers (D_g), such as local, state, and Federal agencies, do not seek to maximize profits from a project. Often it may seem that governmental organizations have as a major objective to take the line of least resistance and minimize the criticism leveled at their actions. However, this is not the entire picture. Government, the largest customer for the construction industry, is facing up to the criticism and demanding increasingly strict performance criteria and cost controls from projects. Life-cycle costing particularly is being used on public projects, and the terms and duration of financing are carefully weighed. Tax considerations are usually not included in the decision-making of governmental developers since they are not required to pay income or property taxes.[1]

The location of the development and nature of the development's needs, especially the economic feasibility of heat balance profiles and size requirements, are crucial in a MIUS evaluation. The availability and cost of trained personnel are also important to governmental developers. The proposed lifetime of the development project must be sufficiently long to justify an independent on-site utility plant. Reliability is important both as internal services are affected and as the environment could be affected from plant failures.

Governmental developers should base their decision-making on estimates of overall net social benefits from their utility choice rather than of net private benefits, as would private developers. This viewpoint may be favorable to MIUS in three ways. First, this implies a longer time horizon in their commitment to a project. Second, local, regional, and national objectives such as energy-conservation and pollution control are given greater emphasis with governmental developers than with private developers. Finally, the governmental developer (Federal, state, or local) might facilitate the removal of institutional obstacles more successfully than a private developer.

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[1]This does not apply to the Federal government to the extent that, in accordance with OMB prescriptions, imputed property taxes are included in conducting a project evaluation.

In summary, governmental developers would probably have the greatest potential number of development sites suitable for a MIUS. Given their long-term social objectives, these developers may be the first to study and implement MIUS on a large scale.

2.5 Implementation of a MIUS

It is useful to speculate on the most likely combinations of participants and roles to implement a modular integrated utility system. In Section 2.2 five participants were identified in the MIUS decision interactions: the private utility company, the public utility company, the private speculative developer, private non-speculative developer and governmental developer. In addition three roles were identified: institutor, owner and operator, and ultimate consumer. The mechanisms by which the participants can assume these roles are shown in Table 2.4.

The participants and roles may also be described by the potential combinations through which a MIUS might be implemented. Table 2.5 provides the 22 most probable combinations out of the 125 possible combinations. The methods of implementation are ranked according to three broad degrees of likelihood: most likely, likely, least likely. Likelihood refers to the probability that MIUS plants will be built in the United States using one of these specific methods of implementation. Both economic analysis and intuition with respect to non-economic issues were used to give a rough intra-group ranking by listing in order of likelihood within the three groups. The relative position of adjacent methods in Table 2.5 cannot be rigorously justified; however, the relative position of non-adjacent methods is thought to be reasonably accurate. The examples given are intended to add clarity, not to be exhaustive. Note that the same development types could acquire a MIUS through several different combinations as indicated by the examples. The remainder of this Section explains the rationale for the rankings in Table 2.5.

It is most likely that MIUS will be implemented by a method that includes governmental participation (indicated by boxes in the table). The majority of the methods ranked as most likely in Table 2.5 include either municipal utilities (U_m) or governmental developers (D_g). Governments (local, state, and Federal) account for the largest portion of all construction projects in this country. Local (city and county) agencies undertake projects suitable for a MIUS such as community colleges, hospitals, and performing arts-recreation centers. In additon, an entire municipality may be considered for an integrated utility system. State agencies develop state universities, penal institutions, hospital complexes, and areas to attract research parks. On the Federal level, public housing projects, military installations, agency offices, and research complexes all provide possible sites for a MIUS. Governments have some advantage in financing when compared with private developers due to tax-exempt state and municipal bonds and income tax revenues. When all costs, private and public (social), are aggregated, the MIUS may be less costly than a set of conventional systems. Furthermore, as mentioned before, institutional roadblocks to integrated utilities confront private developers, particularly at the municipal level. Governmental agencies will not have such severe constraints.

TABLE 2.4

MECHANISMS AND MEANS BY WHICH PARTICIPANTS ASSUME MIUS ROLES

		Participants				
		Private Utility	Public Utility	Developers: Private Speculative	Developers: Private Non-Speculative	Developers: Governmental
ROLES	Institutor	mortgage stocks bonds construction and design contracts	municipal bonds special tax construction and design contracts	mortgage construction and design contracts	mortgage stocks bonds construction and design contracts	Federal tax revenues or bonds construction and design contracts
	Owner and Operator	division in present organization or subsidiary	quasi-public firm or municipal agency	development, cooperatives, or subsidiary	separate entity or subsidiary	quasi-public or government agency
	Ultimate Consumer	incremental power source for the conventional grid	community citizens	people or machines in the development	people or machines in the development	people or machines in the development

TABLE 2.5

LIKELIHOOD RANKING OF METHODS OF IMPLEMENTATION OF

A MIUS WITH DEVELOPMENT EXAMPLES

Most Likely

Institutor	Owner and Operator	Ultimate Consumer	Examples	Line Number[a]
[D_g][b]	[D_g]	[D_g]	military, government agency, prison, hospital, public housing	1
D_{pns}	D_{pns}	D_{pns}	housing, hospital, industrial complex, private university	2
[U_m]	[D_g]	[D_g]	government complex, public housing	3
U_p	[D_g]	[D_g]	government complex, public housing	4
[U_m]	[U_m]	[U_m]	municipality	5
[U_m]	[U_m]	[D_g]	research park, state university, prison	6
U_p	U_p	[D_g]	research park, state university, prison	7

[a]Line numbers are for reference in text only.

[b]The boxes [ ] indicate governmental involvement in that method.

Likely

Institutor	Owner and Operator	Ultimate Consumer	Examples	Line Number[a]
$\boxed{U_m}$ [b]	$\boxed{U_m}$	D_{pns}	new town, housing, hospital, industrial complex	8
U_p	U_p	D_{pns}	new town, housing, hospital, industrial complex	9
$\boxed{D_g}$	$\boxed{U_m}$	$\boxed{U_m}$	isolated community, REA	10
D_{pns}	$\boxed{U_m}$	$\boxed{U_m}$	new town	11
D_{pns}	$\boxed{U_m}$	D_{pns}	hospital, new town	12
D_{pns}	U_p	D_{pns}	hospital, new town	13
$\boxed{U_m}$	D_{pns}	D_{pns}	industrial complex, housing, new town, tourist complex	14
U_p	D_{pns}	D_{pns}	industrial complex, housing, new town, tourist complex	15

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[a] Line numbers are for reference in text only.

[b] The boxes $\boxed{}$ indicate governmental involvement in that method.

Least Likely

Institutor	Owner and Operator	Ultimate Consumer	Examples	Line Number[a]
$\boxed{U_m}$ [b]	$\boxed{U_m}$	D_{ps}	apartment complex, shopping center	16
U_p	U_p	D_{ps}	apartment complex, shopping center	17
$\boxed{U_m}$	D_{ps}	D_{ps}	shopping center	18
U_p	D_{ps}	D_{ps}	shopping center	19
D_{ps}	D_{ps}	D_{ps}	apartment complex, shopping center	20
D_{pns}	$\boxed{D_g}$	$\boxed{D_g}$	public housing: "Operation Turnkey"	21
U_p	U_p	U_p	interface with conventional grid	22

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[a]Line numbers are for reference in text only.

[b]The boxes $\boxed{}$ indicate governmental involvement in that method.

One method of implementation with great potential for MIUS is the municipality, indicated in Table 2.5 as line 5: [U_m - U_m - U_m]. By this method the public utility company would institute, own and operate, and consume the MIUS specifically for and within the municipality. Any municipality that is presently generating power could find it economically advantageous to consider a MIUS. There are about 700 such systems as noted in Table 2.1. There are many reasons why this is an excellent market for MIUS. Municipalities have historically been engaged in multi-utility operations, and the size and heat-balance requirements of a municipality are constant and well-defined by the definite physical boundaries and zoning controls that characterize most communities. This characteristic is important with a pre-set, fixed capacity MIUS. There are an estimated 1400 municipal electrical distribution systems presently functioning in the country which purchase bulk power for resale only (see Table 2.1). Therefore, the number of communities fitting the specifications of an efficient MIUS plant are plentiful, assuming the water and sewer and solid waste distribution systems are already functioning and that municipalities hold the power to allow additional work to be done as needed. Municipalities desire to retain control of their generating capacity, solid waste, and water and sewer authority rather than give it up to privat utilities. In addition, communities could develop a local identity and support for pollution control and energy saving based on self-interest. Financing, as mentioned before, is relatively cheap and accessible through tax-exempt municipal bonds. Since municipalities have the final utility approving authority within their region, a community with a large municipal MIUS may look favorably upon private speculative and non-speculative developers desiring the rights to put smaller MIUS's on their development sites within the community. Municipalities have the utility needs (residential, commercial, and industrial) required to achieve an economic heat recovery utilization with a MIUS. Finally, municipalities have a long time horizon which encourages proper consideration of life-cycle costs and concern for responsible operation and maintenance of a MIUS.

Additional considerations for this method [U_m - U_m - U_m] should be mentioned. First, in the context of a new town, a municipality may be created, thereby changing the legal status of the developer from private to public. This would change the method from line 14 or 15 in the table [U_m - D_{pns} - D_{pns}] or [U_p - D_{pns} - D_{pns}] for example, to line 5 [U_m - U_m - U_m], thus acquiring the advantages discussed above and making MIUS implementation more likely. Second, a separate, quasi-public entity could be created within a municipality to carry out the institutor phase of the development. This entity could use the municipal powers of debt financing and enjoy a waiver of institutional regulations, yet be non-political in nature, thus hopefully incorporating some of the efficiencies of private management. By this method, [U_m/D_{pns} - U_m - U_m], the ownership and operation of the MIUS would revert to public control after the bonds are repaid.

Some drawbacks exist to the method [U_m - U_m - U_m]. First, there is the problem of modifying or replacing the existing utility system infrastructure. Since the costs and inconvenience of installing a MIUS distribution system in an established city may be prohibitive, it is likely that municipalities with urban renewal master plans that include massive reconstructions will be more interested in a MIUS than static communities. Cities that are evolving master renovation plans should include a MIUS in their considerations. Second, a risk of municipal MIUS development is the potentially disastrous costs of a system failure where the community relies solely on a single system for all its utility services.

Another method of implementation of a MIUS included in the most likely group in Table 2.5 is the private non-speculative developer as institutor, owner and operator, and ultimate consumer [D_{pns} - D_{pns} - D_{pns}]. Included in this method are many types of private developments including industrial facilities, private housing projects, private universities, private hospitals, and shopping centers. The economic basis for private non-speculative developers' interest in a MIUS is based on the rising average costs of utility services. To avoid the aggregated inflationary cost increases of the several conventional utilities included in a MIUS, developers may choose the high first cost and the relatively low life-cycle costs of an integrated utility system. Thus rapidly rising costs for conventional utilities, other things equal, will encourage private non-speculative developers to consider MIUS.

Finally, spurred by the pressures or incentives of a governmental development, utility companies could become involved in a MIUS facility. Included in these methods are public housing projects, research complexes, and state institutions such as universities or prisons. These methods are shown as lines 6 and 7 on the table: [U_m - U_m - D_g] and [U_p - U_p - D_g].

The second group in Table 2.5, those methods that are ranked as likely means of implementation, are primarily combinations of private utilities (U_p), public utilities (U_m), and private non-speculative developers (D_{pns}). Development types included are industrial complexes, private housing projects, new towns, private hospital complexes, tourist centers, and shopping centers. Typically, these developments are cooperative efforts between the utility company and the developer with the role of owner and operator being performed by the utility company. Utility companies do not, for the most part, initiate these negotiations for integrated utility development. As pressures from developers become more demanding, each utility will have to establish a corporate policy stating whether an integrated utility alternative is available, and if it is, specifying the requirements that a development project must meet to be suitable for a MIUS. Occasionally, private non-speculative developers may become so frustrated with utility company deliberations that they may offer to institute a MIUS and then sell it to the utility company to own and operate. These methods, shown in Table 2.5 as lines 12 and 13, offer the advantage of control to the utility company without institutor problems and offer the advantage of quaranteed, relatively cheap utility services to the developer without requiring him to become a full-time utility company.

A similar circumstance occurs when a private non-speculative developer builds a MIUS for a new town and then creates a municipal entity out of the new town and a public utility plant out of the MIUS. This is shown on line 11 as [D_{pns} - U_m - U_m].

It is not as likely that the reverse of the combinations discussed in the two preceeding paragraphs will occur. That is, a utility company would probably not institute a MIUS and then sell it to a developer to own and operate, consequently relinquishing control. (These methods are shown as lines 14 and 15 in the table.) Instead, it is likely that utility companies will most often institute, own, and operate the MIUS specifically for the development project. This combination could be expected for housing projects, new towns, industrial complexes, hospital complexes, and many other private non-speculative developments. These methods of implementation are shown as lines 8 and 9 in the table: [U_m - U_m - D_{pns}] and [U_p - U_p - D_{pns}].

Finally, under the Rural Electrification Act (REA), the Federal government has a mandate to provide electric service to isolated communities. A similar procedure may implement MIUS facilities in inaccessible areas as shown by line 10 in the table: [D_g - U_m - U_m].

The third group in Table 2.5 contains the methods of implementation of MIUS that are least likely. These are primarily combinations of private utilities (U_p), public utilities (U_m), and private speculative developers (D_{ps}). Development types included are apartment and housing complexes and shopping centers. Again, it is most likely that the method of implementation of utility services for a speculative developer will incude the utility company in the role of owner and operator, lines 16 and 17, rather than the speculative developer as owner and operator, lines 18 and 19. As mentioned before, the speculative developer is not interested in expending any of his limited energies or resources by getting into the utility business.

If a speculative developer can only achieve his development objectives through providing his own utility services, he may be forced to institute, own, and operate a MIUS for his project. For example, the developers of Montgomery Village, the new town in Maryland that was earlier described as faced with a sewer moratorium, planned to build their own sewage treatment plant.[1] In Table 2.5 this is the method on line 20: [D_{ps} - D_{ps} - D_{ps}].

If a governmental development needs utility services, yet the governmental developer cannot or will not institute a MIUS for some reason, then an unusual combination may arise. As indicated on line 21 in the table, a private non-speculative developer may institute a MIUS and then sell it to a governmental development to own and operate for its project. An example of this method is "Operation Turnkey," used by HUD, where private developers built public housing for the government to own and operate.

Finally, it is quite unlikely that a private utility company would build, own, and operate a MIUS (line 22 in the table) as an incremental power source to supply power only to the conventional power grid. If the utility company is seeking a source to provide an incremental supply for their utility service, they nearly always attempt to buy as large an additional facility as possible. In the case of electric utilities in particular, temporary fluctuations in demand are met through the "power pool" arrangements that exist in regional networks. MIUS may duplicate service already available through the pool, and a MIUS also conflicts with the desired size of incremental facilities. For these reasons it is unlikely that utilities would use a MIUS to interface with their conventional network system.

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[1]In the Montgomery County Sentinel article cited earlier, Mr. Hurley is quoted as saying Kettler Brothers will build a sewage treatment plant capable of treating one million gallons per day to serve 8,000 people at a first cost of $825,000. (p. 2, c. 2).

3. CONCLUSIONS AND SUGGESTIONS FOR FURTHER RESEARCH

3.1 Conclusions

This report covers an initial investigation conducted by informal telephone inquiries selected by successive recommendations of the parties interviewed. The conclusions of the interviewer were that MIUS is most likely to be implemented by a governmental body, such as a municipal utility or governmental developer. It seemed to the interviewer less likely that MIUS would achieve market acceptance and implementation in the private sector given the existing institutional structure and no special incentives supplied by the government.

3.2 Suggestions for Further Research

To extend the economic evaluation of MIUS as compared to conventional utility systems, and to extend the conclusions of this report, two suggestions seem appropriate for further research. First, applications of economic analysis to determine project feasibility would be useful. Potential MIUS sites could be selected on the basis of their likelihood of implementation and evaluated for their economic feasibility with real data. Several recommendations were made by interviewees to explore governmental developments specifically, including military complexes, research facilities, state institutions, hospitals, and public housing projects. These suggestions are consistent with the conclusions of this report. Private non-speculative developments were also proposed for case studies. Once was an old plantation (circa 1850), a development that may be built as a tourist attraction outside of Greenwood, Mississippi. The other is a facility called the Medical Area Service Corporation (MASCO) which serves the Boston Medical Complex. This operation provides utilities to the private hospital center, and it seems well suited for a MIUS. Another recommended development that appears suitable for a MIUS plant is a municipality. An entire municipality, preferably a new town or a city undergoing substantial urban renewal, would offer a broad diversity of utility needs and demand profiles. Many new towns are begun each year, as listed in the Blue Book of American Homebuilders. Two existing communities were suggested as potential case studies. They are Fort Wayne, Indiana, a city of about 200,000 people that is presently undergoing a large renewal of its central business district, and Burlington, Vermont, a city of about 100,000 that has expressed interest in a MIUS facility. (State or regional planning offices can provide names of communities undertaking urban renewal projects, so possible municipalities for a MIUS can be easily identified.) Finally, a large university or a university and an adjacent college town might be excellent sites to test a MIUS. The installation would be relatively free of political controversy, and careful, professional study of the operation could be made by the university faculty. Both Ohio State University and Pennsylvania State University with the community of University Park have been suggested. (A letter inquiry by officials at HEW to universities and hospitals concerning the use of integrated utility systems as a potential cost reducing mechanism did elicit responses indicating favorable interest. This was done subsequent to the completion of the investigation reported above, and is not included in its discussion.)

Aside from the research recommended below, a more controlled and carefully documented version of the method used in this report could be implemented. Such a report would include a list of the questions which were asked, would indicate whether all interviewees were asked the same questions, would indicate how various terms were defined for the interviewees and would explain the extent to which the interviewees had the opportunity to peruse the results and the interpretations of the comments they made. Statistical analysis of the responses to such a survey might elicit significant differences among the classes of interviewees.

Thus to summarize the first recommendation for further research, potential project sites should be identified, and researchers should gather and analyze economic data to determine if a MIUS is economically feasible at those sites.

A second recommendation for further research is to explain the economic and non-economic factors that interact in the decision process by utility companies and the developers in evaluating a MIUS against a set of conventional utility systems. From such a study a detailed flow chart could be constructed describing the order and interactions of all the decision factors -- technological, economic, political, legal, and environmental -- that enter into the selection of a utility system. Appendix C, a brief flow chart containing some of the non-economic criteria, has been included to provide a starting point for this proposed study.

Appendix A

Changes in Electric Power Prices: Impact on MIUS

To understand the possible responses of utility companies to MIUS as an alternative for providing utility services, it might be helpful to explain some of the economic principles that underlie the provision of utility services in the United States. The electric power industry, primarily composed of private companies but also including public companies, will be discussed as a general representative of all forms of utility operations in order to simplify the discussion.

Electric utilities are "natural monopolies" (i.e., they have no direct competitors in the region where they generate) and are therefore subject to economic regulation to prevent socially inefficient economic policies. Since utilities have a franchise commitment to serve all customers in their area, regulatory commissions have established "fair-return" or average-cost pricing policies for utility companies to ensure lower prices and larger production than would exist with an unregulated monopoly. Average-cost pricing sets the price (or rate) charged equal to the average cost of production of power. Average cost is defined as the total cost[1] divided by the number of units produced. Average-cost pricing means that costs will just be covered, including an allowance for a "fair return." Monopolists without regulation would attempt to increase profits by restricting output and charging higher prices than under competitive conditions.

Historically, the electric power industry has experienced declines in the real price of power. Figure A.1 illustrates this decrease in price. Two factors in combination probably account for much of the decline in price. First, the average cost curve has shifted downward (AC_1 to AC_2) due to technological change. Second, the demand for power has increased (D_1 to D_2) in the range of decreasing average cost. Figure A.1 shows that a new price, P_2, and new quantity of electric service, Q_2, result from a shift in average cost from AC_1 to AC_2 if demand remains on the curve D_1. Furthermore, an extra decrease to P_3 and increase to Q_3 result if demand shifts from D_1 to D_2.

Consumers of electric power appear to have gained some benefits from decreasing prices over the period from 1930 to 1968. But since 1968, the factors which had provided decreasing average costs in electricity production have appeared to be overwhelmed by a substantial increase in the cost of capital, by labor settlements with wage increases beyond those justified by increased productivity, and by the need to increase plant reserves.[2] The result has been an increase in average costs, as shown in Figure A.2 by a shift from AC_1 to AC_2. Given the large increase in demand during this same period (D_1 to D_2), both the new price, P_2, and quantity, Q_2, are higher.

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[1]Total cost is defined as the aggregate dollar expense needed to produce each level of output quantity. Total costs include fixed costs and variable costs.

[2]Edwin Vennard, "Changed Economic Climate and the Impact on Rates and Earnings," paper presented before the American Power Conference, Chicago, Illinois, May 9, 1973, pp. 1-2.

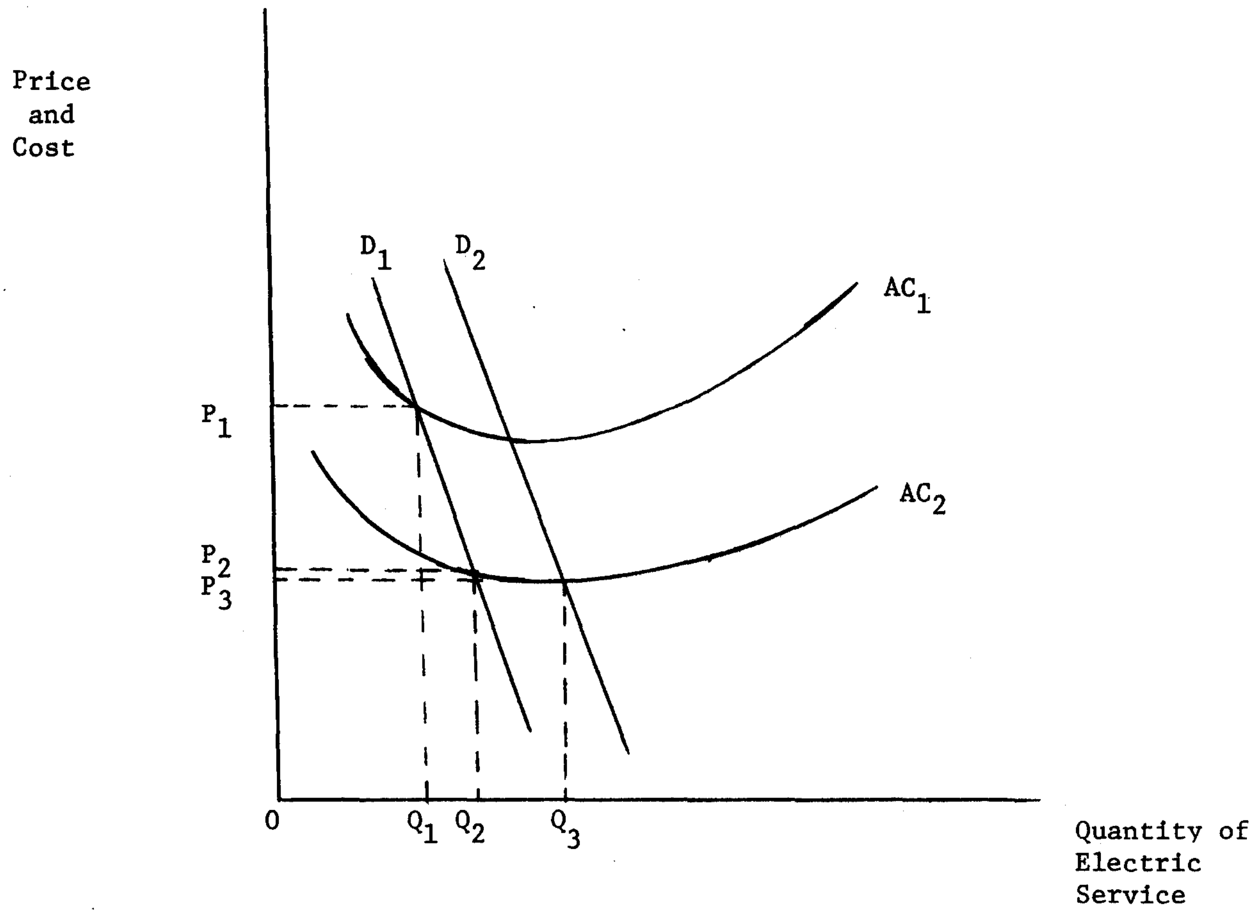


Figure A.1 -- Regulated Monopoly:
Average-Cost Pricing

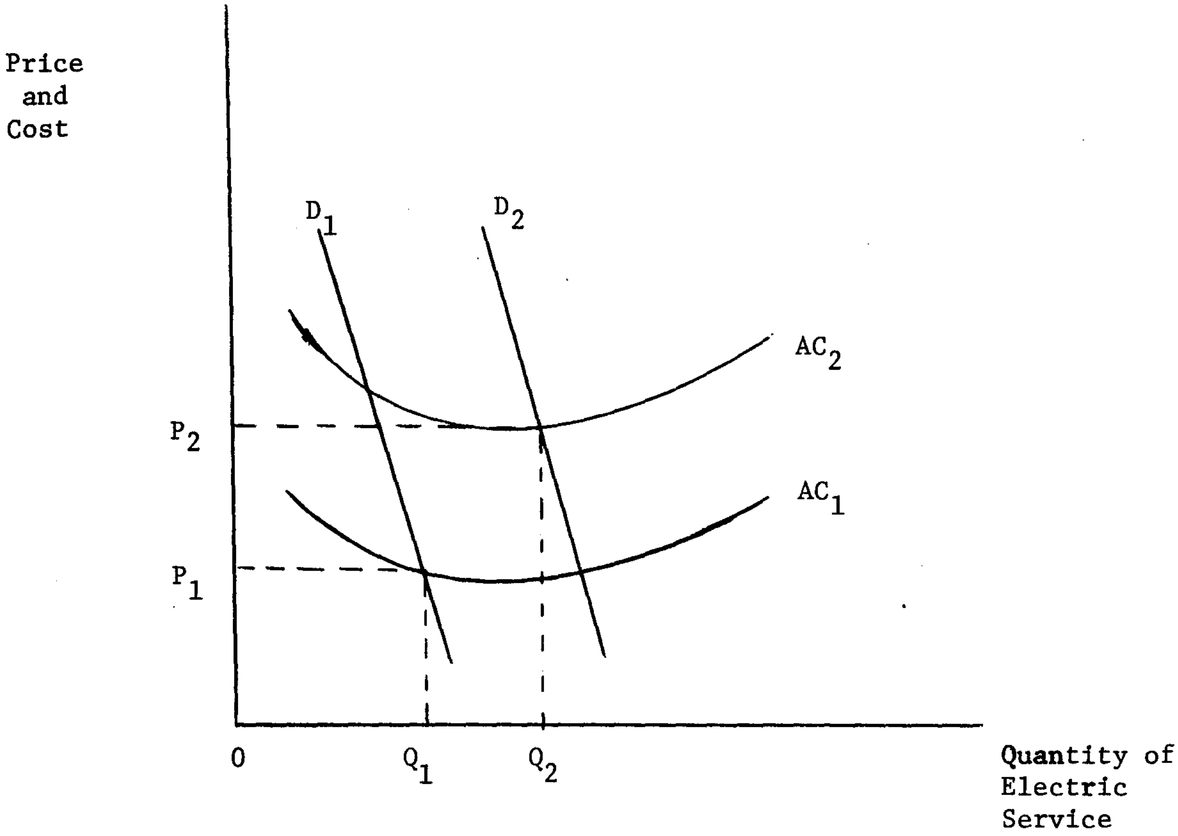


Figure A.2 -- Regulated Monopoly After 1968

This trend of rising electric power prices after 1968 might provide some encouragement for large-demand customers to consider a self-sufficient MIUS as an alternative to conventional sources. Moreover, MIUS is not solely a power generating facility. If the electric utility business is in fact representative of all forms of utility services and average costs have increased for all of the five possible utility services included in a MIUS, then the MIUS concept may become cheaper than the separate conventional utility services.

Appendix B

List of Interviewees

Private Utilities

1. Arkansas Power and Light

   9th and Lewis
   Little Rock, Arkansas 72203
   (501) 372-4211
   Mr. Les Blades

2. Pennsylvania Power and Light

   Allentown, Pennsylvania
   (213) 821-5747
   Mr. Bladwin

3. Potomac Electric Power Company

   1900 Pennsylvania Avenue, N.W.
   Washington, D.C.
   (202) 872-2000
   Mr. Benzinger (Mr. Derrick)
   V. P. Generation

4. Salt River Project

   Phoenix, Arizona
   (602) 273-5900
   Jim Guinane

5. *Southern California Edison

   (213) 572-2001
   Ed Myers
   V. P. Corporate Communications

6. Southern Services

   (404) 252-6112
   Clarence Grune

7. *Union Electric Company

   St. Louis, Missouri
   (314) 621-2046
   George Wagner

8. *Union Electric Company

   St. Louis, Missouri
   (314) 621-0711
   Mr. Marting

Public Utilities

1. Burlington Utilities

   Burlington Utilities
   (302) 658-0300
   Mr. Young
   Chief Engineer

2. City Utilities

   Fort Wayne, Indiana
   (219) 423-7129
   Carl Wall (Mr. Mendal)
   General Manager

3. Edmonton Power

   Edmonton, Canada
   (403) 425-3117
   Mr. W. R. Kirkland
   General Manager

4. Greenwood Utilities

   Greenwood, Mississippi
   (615) 453-7234
   C. M. Mathews
   Manager

5. Nashville Thermal Transfer Corp.

   Nashville, Tennessee
   (615) 255-1460
   Carl Avers

*These people were contacted twice.

Developers

1. Disney World

   Orlando, Florida
   (305) 824-2222 Ext. 4395 or 4396
   Mr. James Holt

2. General Development Corporation

   Port Charlotte, Port Malabar,
   Port St. Lucie, Florida
   (305) 350-1111
   Mr. Smidt
   President of General Development Utilities

3. Gilette Company

   Boston, Massachusetts 02199
   (617) 261-8500
   Mr. George A. Wallace
   Facilities Engineer

4. Kettler Brothers

   19110 Montgomery Village Avenue
   Gaithersburg, Maryland 20760
   (301) 948-4000
   Mr. Hurley

5. *Medical Area Service Corp. (MASCO)

   Boston, Massachusetts
   (617) 738-5000
   Mr. Dave Elovitz
   Executive V. P.

Trade Associations

1. Electric Energy Association, Inc. (Private)

   1015 18th Street, N.W.
   Washington, D.C.
   (202) 223-2720
   Scribner Allen

2. The Electrification Council (Private)

   Washington, D.C.
   (212) 986-4100 Ext. 203
   Mr. Robert A. Morris

3. Canadian Elec. Association (Private)

   Montreal, Canada
   (514) 935-7471
   Mr. Campbell

4. American Public Power Association (Public)

   2600 Virginia Avenue, N.W.
   Washington, D.C. 20037
   (202) 333-9200
   Mr. Herbert Blinder

5. National Assocation of Home Builders (Developers)

   1625 L Street, N.W.
   Washington, D.C.
   (202) 737-7435
   Mr. Smithman

*These people were contacted twice.

Regulatory

1. National Association of Regulatory Utility Commissioners

   628-7326
   Mr. Everette Kreeger
   Secretary-Treasurer

2. District Public Service Commission

   Washington, D.C.
   (202) 629-5936
   Mr. Norman Belt

3. Federal Power Commission

   Washington, D.C.
   (202) 386-6483
   Mr. Phillips

4. Federal Trade Commission

   Washington, D.C.
   (202) 962-0193
   Mr. Garvey

Engineers

1. Gilbert Associates

   Reading, Pennsylvania
   (215) 775-2600 Ext. 710
   Mr. Herbert Hollander

2. Charles T. Main, Inc. Consulting Engineers

   Boston, Massachusetts 02199
   (617) 262-3720
   Edwin Vennard

3. Westinghouse

   East Pittsburgh, Pennsylvania
   (412) 256-2038
   Mr. Robert L. Dunning

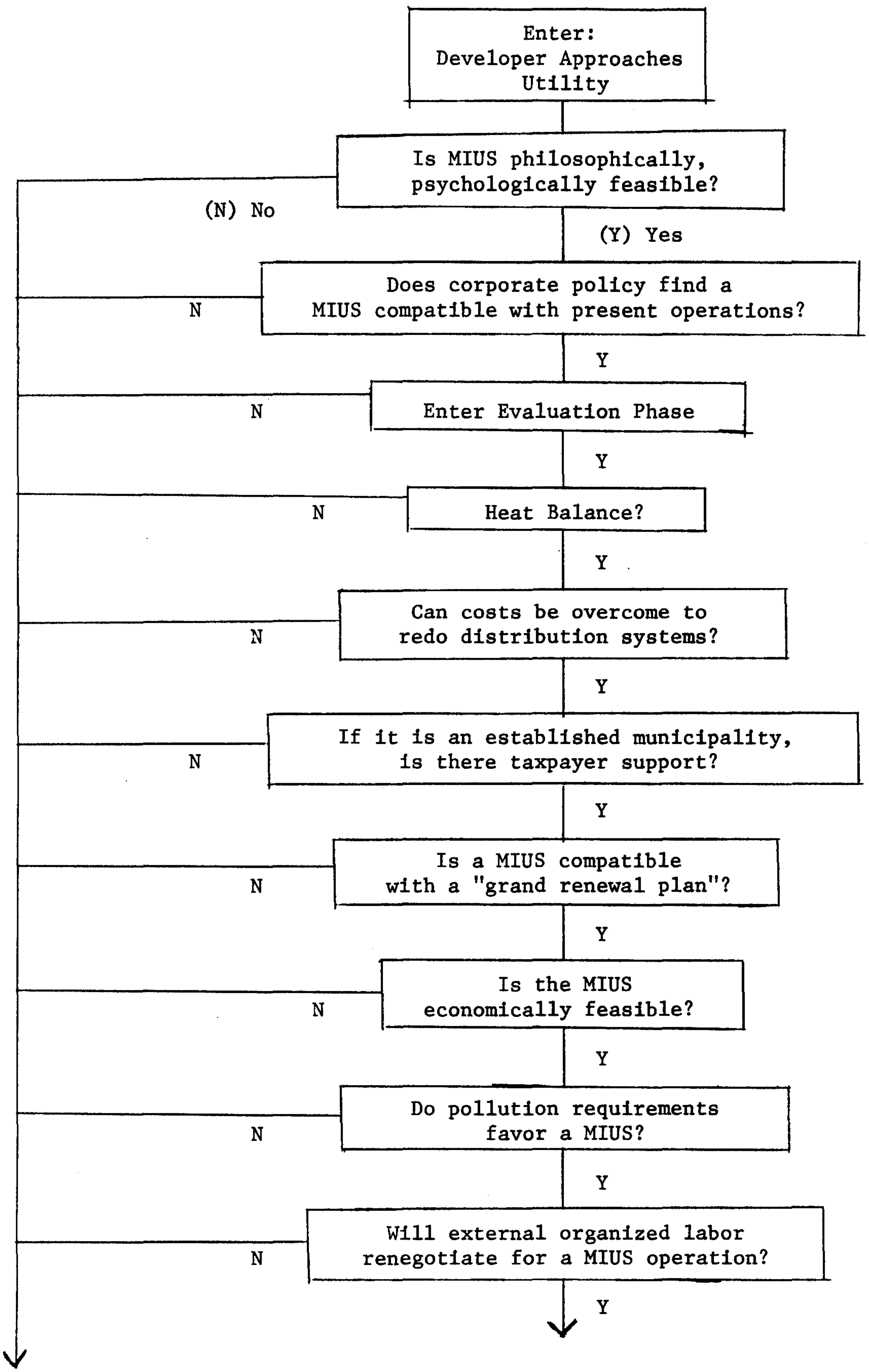
Other

1. Lowell Gas Company

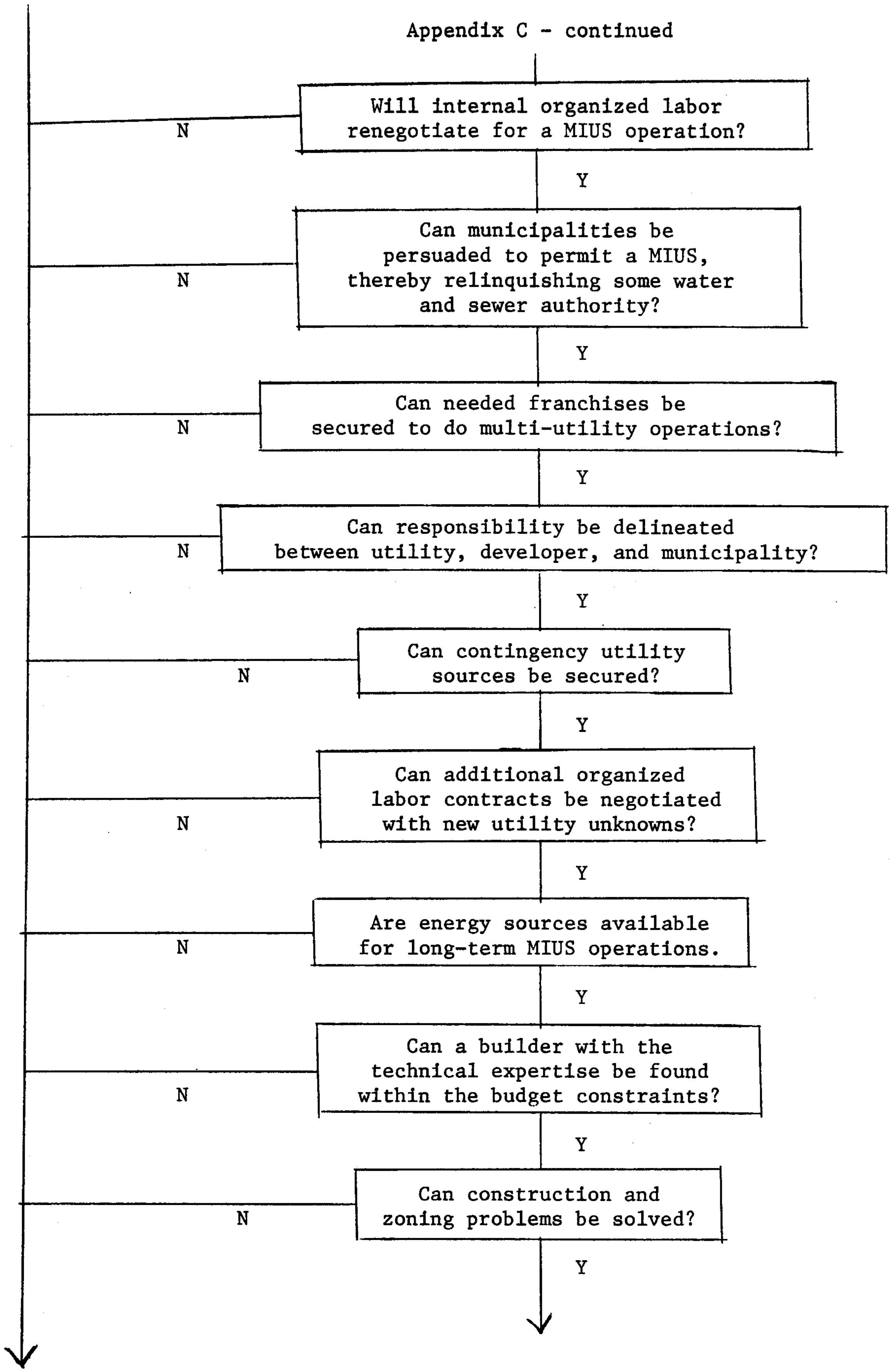
   Lowell, Massachusetts
   (617) 458-1231
   Bruce Tibbits

Appendix C

Flow Chart of MIUS Decision Process



Appendix C - continued



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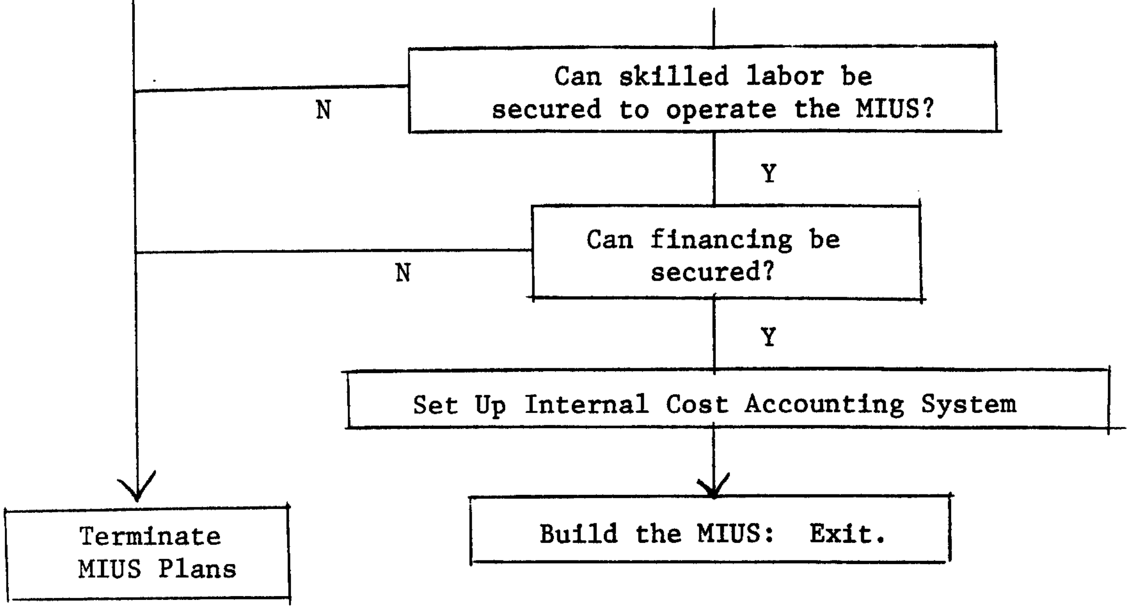

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16. ABSTRACT *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here.)*

This report provides information to the Department of Housing and Urban Development-Modular Integrated Utility System (HUD-MIUS) program about the economic decision-making process for implementation of a MIUS by utility companies, developers, and a combination of these two groups.

Information was obtained through informal telephone interviews from these participant groups about their economic analysis of utility investment alternatives. The content of these conversations was synthesized into economic criteria which are perceived by each participant to be most important in evaluating alternative utility investments. From the analysis of these economic criteria, the possible combinations of participants and roles in the implementation of a MIUS are specified. These combinations are ranked, according to the degree of likelihood that each method will actually be employed.

The conclusion of this report is that a MIUS is most likely to be implemented by a governmental body, such as a municipal utility or governmental developer.

17. KEY WORDS *(six to twelve entries; alphabetical order; capitalize only the first letter of the first key word unless a proper name; separated by semicolons)*

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