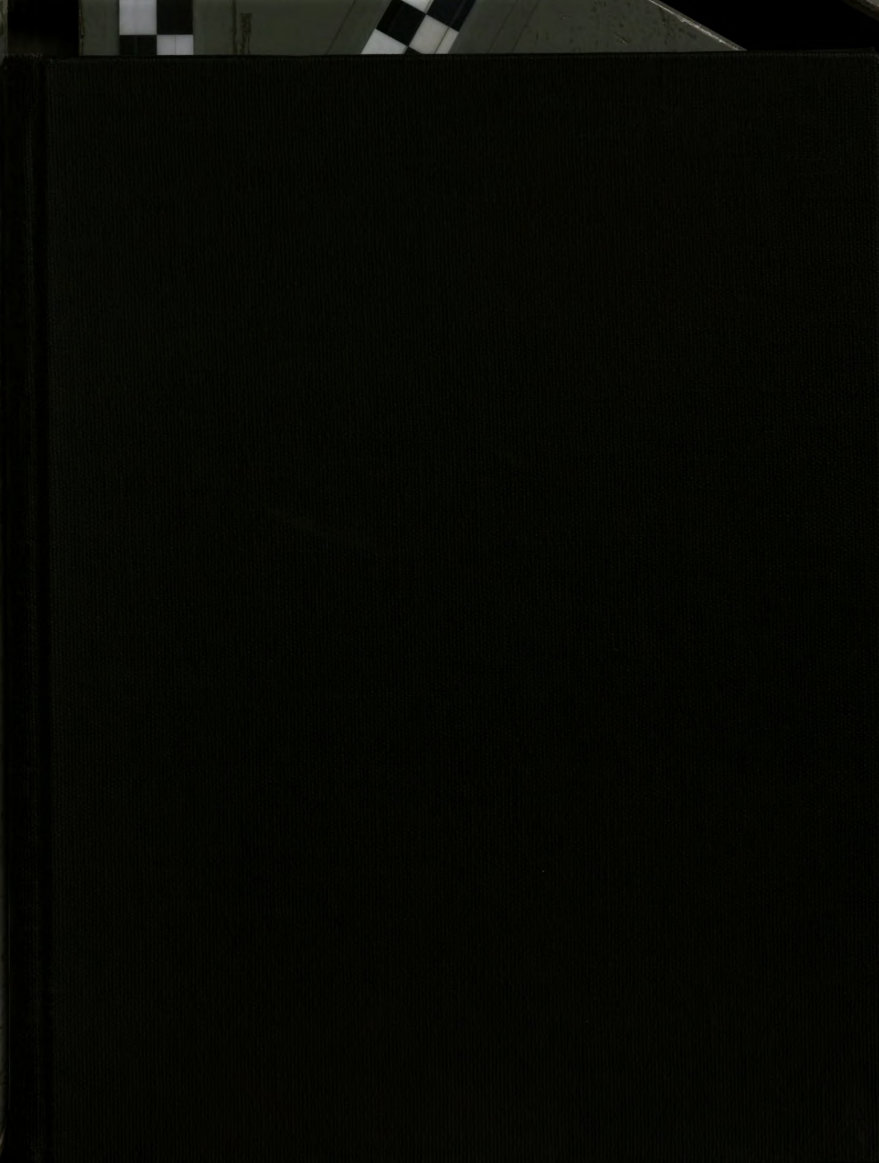






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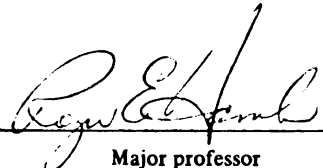
thesis entitled

THE IMPLEMENTATION OF MINNESOTA
ENERGY-RELATED LAND-USE LEGISLATION
BY LOCAL GOVERNMENTS
presented by

ROBERT LOREN WUORNOS

has been accepted towards fulfillment
of the requirements for

PH.D. degree in URBAN & REGIONAL PLANNING


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THE IMPLEMENTATION OF MINNESOTA
ENERGY-RELATED LAND-USE LEGISLATION
BY LOCAL GOVERNMENTS

by

Robert Loren Wuornos

A DISSERTATION

Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of

DOCTOR OF PHILOSOPHY

Department of Urban and Regional Planning

1982

ABSTRACT

THE IMPLEMENTATION OF MINNESOTA ENERGY-RELATED LAND-USE LEGISLATION BY LOCAL GOVERNMENTS

BY

ROBERT LOREN WUORNOS

The purpose of this investigation was to determine the extent to which Minnesota's energy-related land-use legislation has been implemented by local units of government throughout the state. The legislative focus included municipal, county and metropolitan planning, zoning, and subdivision regulations of which some were mandatory and some were permissive. The primary legislative concerns of this effort were related to solar access and earth shelter structures.

This investigation was divided into three sub-problems. The first sub-problem relates to the historic development of energy legislation in the state of Minnesota. The second sub-problem was to identify legislation pertinent to this research. The third sub-problem was to identify the degree to which this legislation has been implemented at local levels of government. The information needed for sub-problem three was collected by using a random sample telephone survey of city and county governments throughout the state. Survey results were compiled according to five categories: 1) county, 2) small size cities, 3) mid-size cities, 4) large size cities, and 5) cities within the Twin Cities Metropolitan Region.

It was discovered that the degree of implementation of the various legislative opportunities was not substantial. The relevant state legislation has not been effectively implemented on a statewide basis in counties, small size cities, and mid-size cities. However, evidence indicated that large size cities and cities within the metropolitan region were implementing the related legislative opportunities.

To my family and friends
for their support and en-
durance throughout this
ordeal.

ACKNOWLEDGMENTS

Appreciation is extended to Dr. Roger Hamlin for his skillful guidance in the preparation of this dissertation; to Sally Anderson, Kerry Ogren and Jeanne Wuornos for their assistance with telephone surveys; and to Dr. H. Roger Smith, who encouraged the author to pursue higher academic goals.

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CHAPTER I

INTRODUCTION

A. Problem Statement

The goal of this research is to answer some key questions regarding the relationships between Minnesota energy-related land-use legislation and the effectiveness of this legislation as it is applied at the local levels of government. Three objectives, which are presented in the form of sub-problems, constitute the major contribution of this research. First, a historic perspective of energy-related land-use policy will be developed to provide an understanding of the perceived need for such legislation. This will serve as a point of departure from the subsequent research. Second, pertinent state legislation will be identified and categorized as either mandatory or enabling legislation. The focus of the remaining research will be on the related legislation. Third, the degree to which the related legislation has been incorporated into local ordinances and regulations will be surveyed and analyzed. The results of this research will be analyzed to formulate practical guidelines for further development of energy-related land-use policies at the state and local levels.

Succinctly stated, the purpose of the proposed investigation is to determine the extent to which Minnesota's energy-related land-use legislation has been implemented by local units of government.

B. Problem Significance

In 1969, the University of Minnesota Experimental City Project Pro-

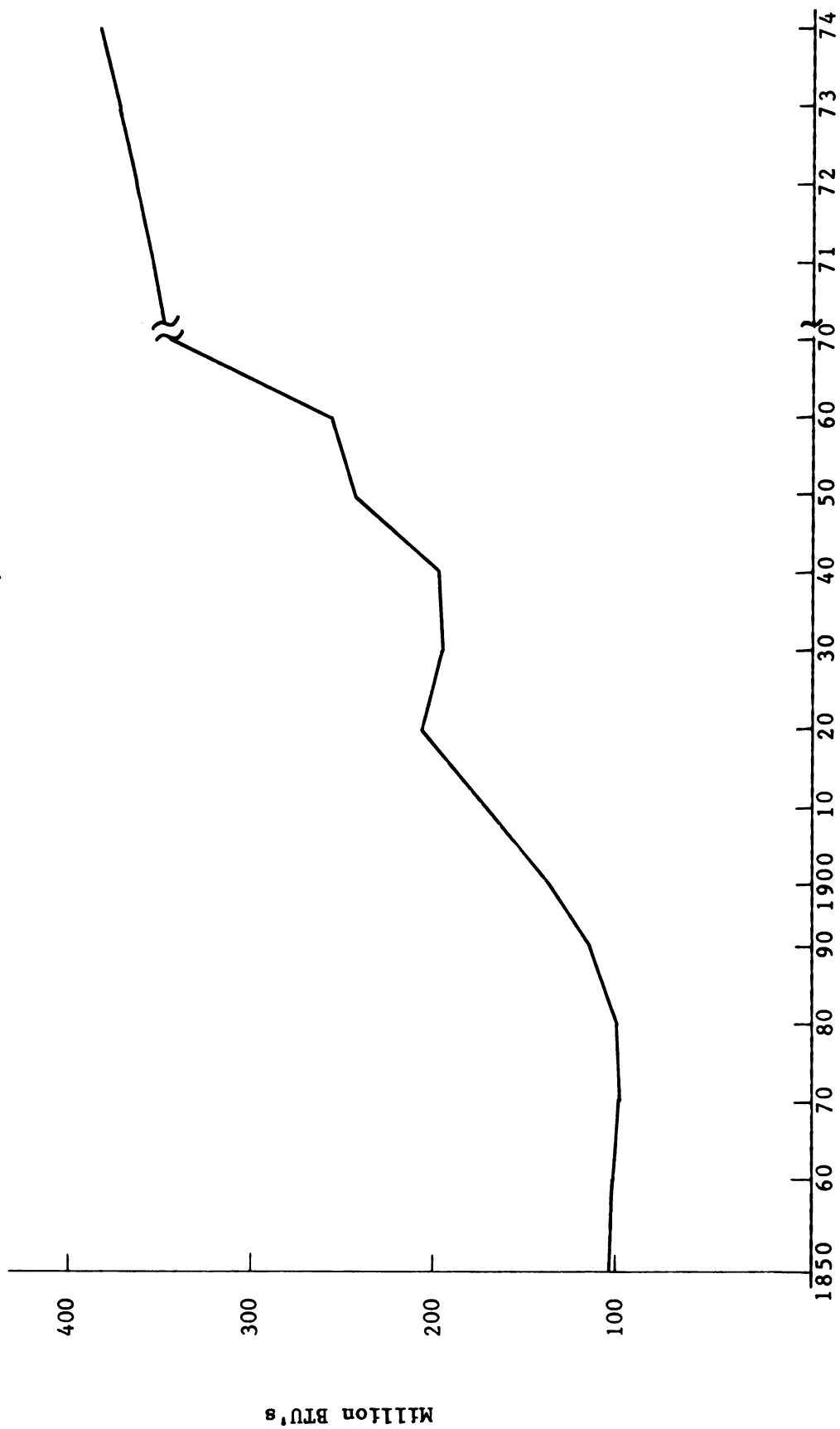
gress Report stated in a brief section pertaining to energy, "All indications point toward the availability of more power at lower rates... The promise of the future is to utilize this cheap power to free man from many tasks which he is presently doing."¹ This statement was in reference to the use of energy in a proposed experimental city within the state with a target population of 250,000. The statement reflects a prevailing attitude at that time that energy was relatively inexpensive and abundant. In effect, this presented a rather unusual attitude toward energy resources which were not thought to be limited.

The energy picture has changed considerably since 1969. Traditional energy sources such as oil and natural gas have been recognized as being limited. The perception of the energy problem has changed to the point where federal and state energy agencies have been formed to address the public concerns about energy resources and energy management.

The global problems related to energy management have reached into all aspects of human activity and constantly demand attention. It has been determined that the peak of production in natural gas and petroleum in the United States occurred in the early 1970's and that world production of oil is expected to peak between 1985 and the year 2000, if present trends continue.² The problem of limited future energy supply is compounded by the continuously increasing per capita and total energy consumption patterns (Figure 1). The inferential conclusion, of course, is that the global community is and will be faced with the problem of distributing limited energy supplies to a market with an ever-increasing energy demand.

A cursory review of consumption patterns reveals a rather grim picture for energy intensive societies. Will it be necessary to curtail

Figure 1-1
U.S. ENERGY CONSUMPTION PER CAPITA, 1850-1973



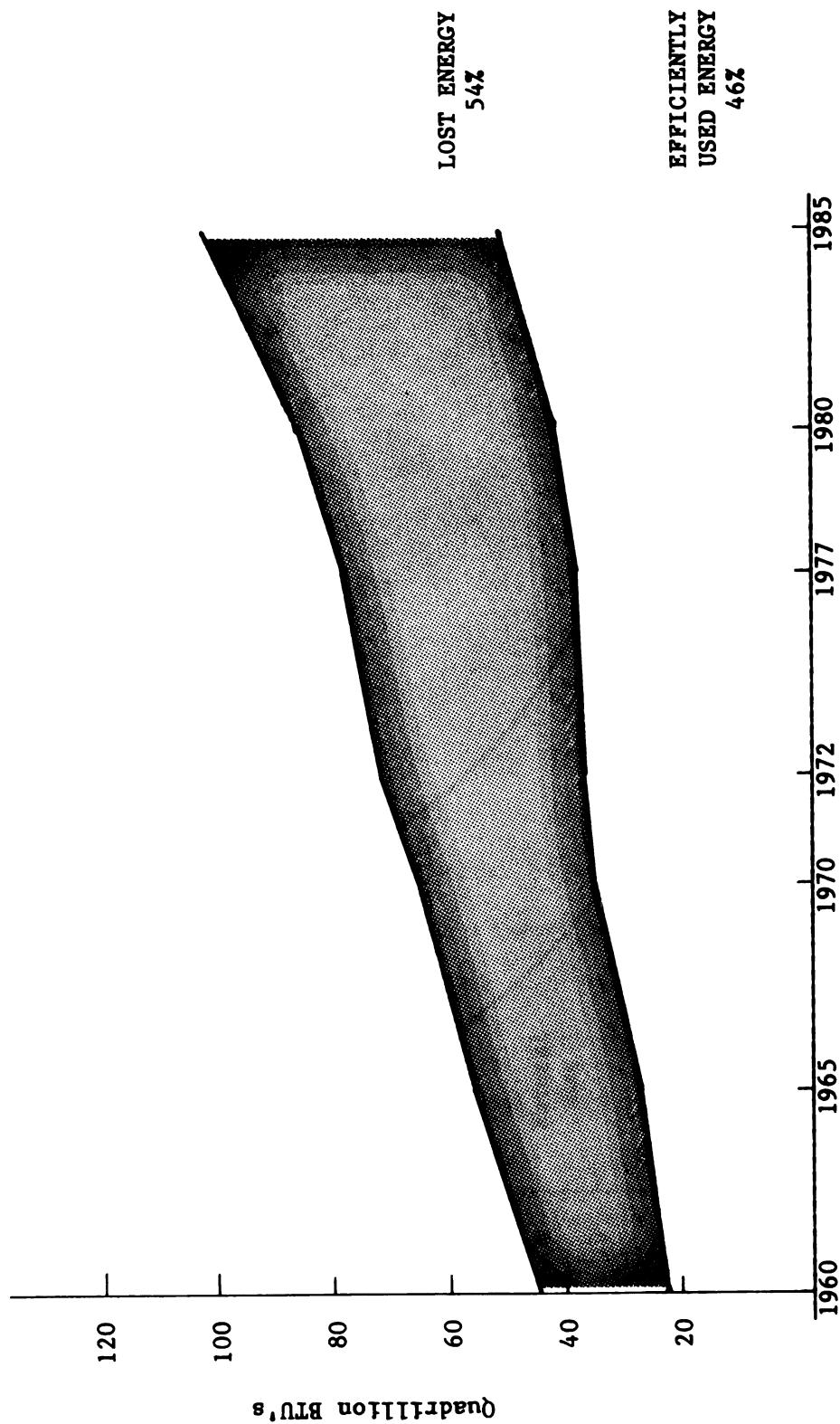
Source: Koenig, Herman E., "Energy Conservation:
Imperative and Opportunity."

energy intensive human activities? Must production be decreased? Will travel patterns be substantially limited? What radical changes does the future hold in store for human activity? These are some of the questions which have and will be addressed by politicians, technicians, and scholars.

Ultimately, probes launched by all individuals and groups concerned with energy consumption patterns will be directed toward energy efficiency of human activities. This seems to be a legitimate concern since it has been demonstrated that approximately fifty percent of all energy produced is lost (Figure 2). Essentially, this means vast amounts of energy (an estimated forty quadrillion BTU's in 1980) could be channeled into efficient production and usage if it could be harnessed. Moreso, it has been determined that the transportation sector is the least efficient user of energy. With an input of mostly oil, it lost or rejected over 75% of that energy input.³ Retrieval of the energy lost through transportation inefficiencies alone could amount to a substantial gain to society.

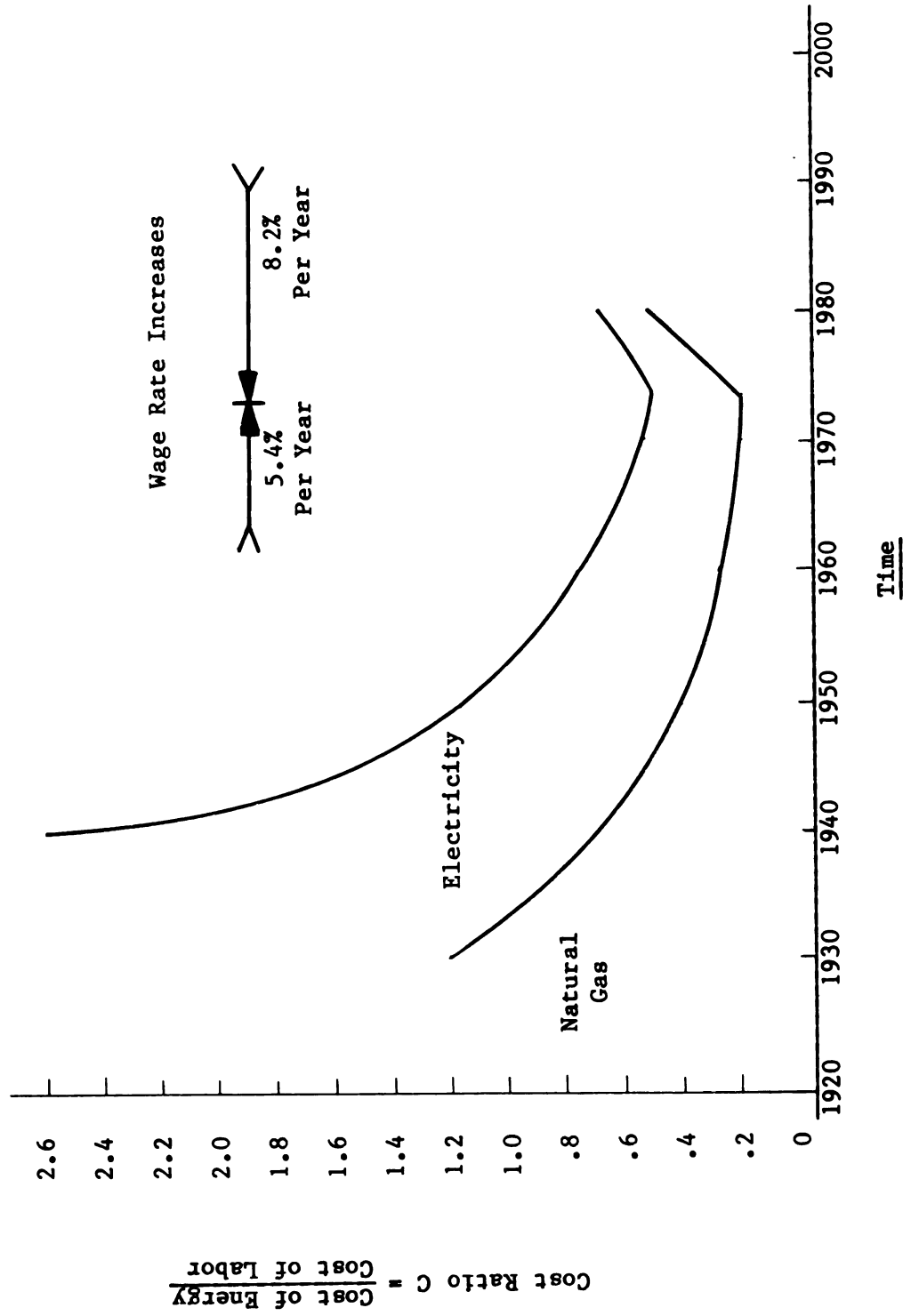
The phenomena associated with increasing energy demands and limited supplies has moved industrialized societies (the United States in particular) into a new era. With respect to the cost structure of energy, it is an era that is characterized as being resource-limited instead of demand-driven and involves rising rather than declining real costs of energy.⁴ Until 1973, the real cost of energy with respect to wage rates (adjusted by consumer price index) displayed a decreasing pattern over a forty year period (Figure 3). This trend reversed itself in 1973 and has since shown an increasing real cost of energy. The current trend is expected to continue into the indefinite future, though on a shorter time frame a variety of political forces will attempt to mitigate against this basic physical phenomenon through subsidies and wage negotiation.⁵

Figure 1-2
EFFICIENCY OF ENERGY UTILIZATION, 1960-85



Source: Koenig, Herman E., "Energy Conservation: Imperative and Opportunity."

Figure 1-3
CHANGING COST OF ENERGY RELATIVE TO WAGE RATES



Source: Koenig, Herman E., "Energy Conservation:
Imperative and Opportunity."

If the rising real energy cost assumption proves correct, it will bear significant ramifications for the future distribution of all human activity. Personal and societal trade-offs will, out of necessity, be adjusted accordingly.

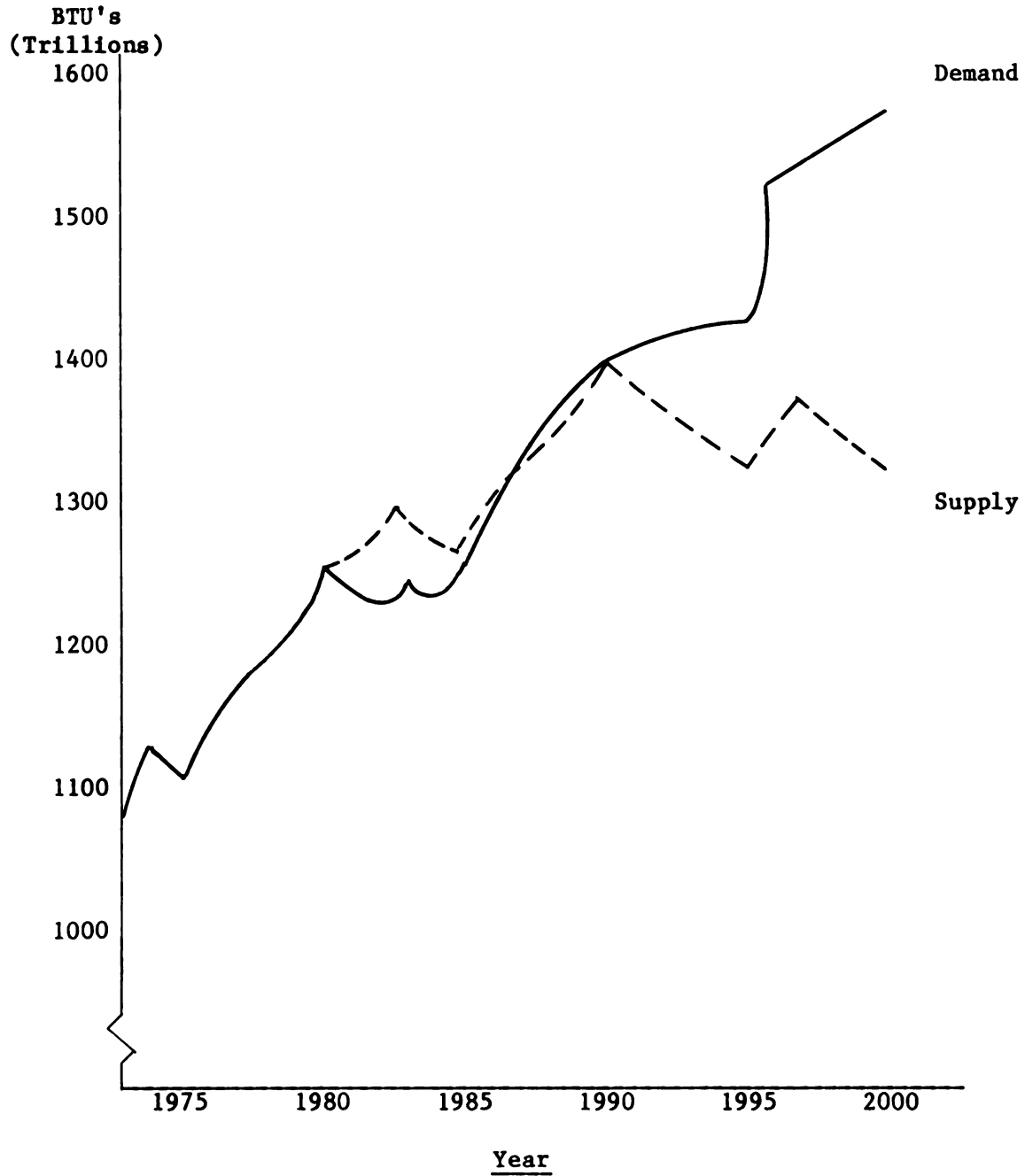
The Minnesota Energy Agency has conducted research related to state energy supply and demand to the year 2000. The resultant base-line forecast indicates that the state energy supply will keep pace with energy demand until 1989 (Figure 4). At this point in time, demand will continue to rise while supply begins to decrease. According to the Minnesota Energy Agency, this trend will result in three major impacts. The first impact is rapidly rising prices. The second major impact is the continued dependence of Minnesota and the nation on foreign oil. The third related major impact is a slow-down and eventual termination of economic growth in the state and a decline in employment.⁶

All human activity associated with energy consumption must be scrutinized in an effort to determine the most energy efficient and cost effective methods of reducing energy demands. One such human activity requiring considerable research is energy consumption of transportation as it relates to human settlement patterns. Are some settlement patterns more efficient than others? Research conducted by Robert Peskin at Northwestern University indicates that certain settlement patterns might be more efficient. Particularly when coordinated with the existing transportation network or improvements to that network, directed urban growth can result in more energy-efficient urban forms than sprawled development. He determined that a polynucleated city was the most energy efficient due to the close proximity of homes to work locations.⁷

The Minnesota Energy Agency has developed a set of policies to help

Figure 1-4

MINNESOTA BASELINE PRIMARY ENERGY
SUPPLY AND DEMAND TO YEAR 2000



Source: Minnesota Energy Agency, 1980 Energy Policy and Conservation Biennial Report.

offset the energy production problem. Conservation is seen as an opportunity to provide a tremendous amount of untapped potential for the state of Minnesota. Opportunities exist, which are both technologically and economically feasible, that can lower the state's overall demand for energy by almost 20% by the year 2000. The opportunities include:

1. Weatherproofing of existing buildings
2. Construction of energy efficient new buildings
3. Energy-efficient operations and maintenance in commercial and industrial buildings processes
4. Efficient energy-using appliances and industrial equipment
5. Efficient driving techniques
6. Efficient cars and trucks
7. Land-use planning and development keys to energy efficiency.⁸

The intent of this research is to focus on item 7 in the above paragraph. According to interviews with officials from the Minnesota Energy Agency, no research has been completed to date which directs its attention to the research topic at hand. The principal reason given for this lack of research is the current lack of funds at the state level coupled with personal cutbacks at the State Energy Agency. Officials of the State Energy Agency recognize a need for this research,⁹ however, they also recognize the inability of this research to be conducted by the State Energy Agency at this time.

C. Delimitations

For purposes of this investigation, the following delimitations are made:

1. The legislation which will be considered for this research

is limited to those pieces of legislation applicable to land-use at municipal and county levels.

2. There will be no consideration of legislation related to direct transportation energy consumption associated with land-use patterns.
3. A survey of county government will be limited to a random sampling of which the size of the sample will be determined by appropriate sampling techniques.
4. A survey of city governments will be limited to a random sampling of which the size of the sample will be determined by appropriate sampling techniques.
5. The survey of cities will be limited to cities with a 1980 population greater than 1000.
6. Township governments will not be considered in this research.

D. Statement of Hypothesis

It is hypothesized that Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the local level on a statewide basis.

E. Remainder of This Thesis

A brief discussion of the early development of energy-related land use (particularly Greek and Roman efforts) sets the stage for the more recent efforts of the United States and, in particular, Minnesota. Included in Chapter Two is some of the motivation for the development of energy-related land use legislation of the respective governments. The pertinent legislative acts are identified and the sections related to

this research are isolated. Chapter Three provides a description of methodology employed in this research. Three sub-problems are identified and the respective approach to the solution of each is defined. The compilation of data gathered for each sub-problem is presented in Chapter Four. Chapter Five discusses the interpretation of research results. Chapter Six includes a discussion of state policy implications and presents some conclusions as to future directions for energy-related land-use legislation.

The appendices of this report include the key state legislation to which this research was directed.

References to Chapter I

1. University of Minnesota/Experimental City Project, The Minnesota Experimental City Progress Report, May, 1969, 3rd Edition, p.6.
2. Herman E. Koenig, Ph.D., "Energy Conservation: Imperative and Opportunity," Prepared for Energy Seminar for Michigan Legislators and Staff, September 11, 1978, p.1.
3. Francis X. Murray, Energy: A National Issue, The Center for Strategic and International Studies, Georgetown University, Washington, D.C., 1976, p.6.
4. Herman C. Koenig and Thomas C. Edens, "Evolutionary Adaptations in Western Food Systems," Testimony to the Presidential Commission on World Hunger," Chicago, Illinois, April 25, 1979, p.9.
5. Ibid., p.8.
6. Minnesota Energy Agency, 1980 Energy Policy and Conservation Biennial Report, St. Paul, Minnesota, 1980, pp.1-3.
7. Robert L. Peskin, The Impacts of Urban Transportation and Land Use Policies on Transportation Energy Consumption, unpublished Ph.D. dissertation, Department of Civil Engineering, Northwestern University, June, 1977, p.171.
8. Op. Cit., pp.1-5.
9. Interviews with officials of the Minnesota Energy Agency and the Minnesota Office of Local and Urban Affairs.

CHAPTER II

RELATED LITERATURE

A. Introduction

A preliminary literature review was performed to investigate the availability of literature related to this inquiry. The approach was to first begin with doctoral studies, then books and government documents, and finally articles in scholarly journals which treated the subject matter. An examination of Dissertation Abstracts International: A--The Humanities and Social Sciences, and the Comprehensive Dissertation's Index: Social Sciences and Humanities, Part 2 revealed no doctoral dissertations related specifically to the proposed study.

B. Early Considerations for Energy-Efficient Land-Use

The consideration of energy efficiency in human settlement patterns is hardly a revolutionary activity stemming from recent petroleum shortages in the marketplace. Rather, there is evidence that the need for warmth in housing has influenced settlement patterns and dwelling unit type and orientation in European and Asian societies many centuries ago.

The conscious application of passive solar technology has been traced by Butti and Perlin to the Socratic era in Greece. Houses were designed for passive solar heating as is evidenced by the following:

During this time period, the Greeks built their homes so the winter sunlight could easily enter the house through a south-facing portico similar to a covered porch. Not only were the main rooms in the house warmed by the rays of the sun streaming through the portico, but they were sheltered from the north to keep out the cold winds.¹

There is also evidence that thought was given to solar access for

the dwelling units by planning cities to maximize southern exposure for these units. The city of Olynthus in Greece was one such city. This city was designed with an east-west orientation such that each housing unit had maximum access to the sun's energy.² By orienting the housing to the south, it was possible to take advantage of the low angle of the sun during the colder winter months. It was also possible to effectively prevent the heat of the sun's rays from penetrating the interior during the hot summer months.

Although the concept of south-facing dwelling units is generally accepted by modern day solar housing theorists, this concept has not been commonly adhered to throughout the historical settlement patterns of cultures. A case in point is the Zeilenbau (row-house) plan in Germany of the 1920's. Many of these row-houses faced east and west, with the intent of providing maximum orientation to the sun. Initially, this concept met with favor amongst planners and architects. Unfortunately, the Zielenbau plan proved to be less advantageous than originally believed. The following account describes the folly:

The winter sun is in the south all day -- rising in the south-east, and moving due south at noon, and settling in the south-west. Thus, the east and west windows received only modest amounts of sunlight on winter days because the sun's rays struck them at a glancing angle. And, in the summer, just the opposite occurred -- the bright rays of the morning and afternoon sun came straight into the east and west facing rooms.³

Another case in which solar access was apparently poorly considered was in the laying out of cities in the United States. Most of the cities whose street patterns were layed out prior to 1950 are predominately oriented such that houses face east or west. One result of such lack of consideration for solar effects is that a large portion of the housing

stock in the United States is subject to the same disadvantages of the Zielenbau plan. This housing stock is, in most instances, unable to take advantage of solar technologies which increase the heating and cooling efficiency of the individual units.

As with solar access, earth shelter housing has its origins in centuries bygone. Prehistoric cave dwellers sought refuge in natural caverns. Later, early Asian and European societies actively developed earth shelter housing. In the Scandinavian countries, sod houses provided a particular type of earth sheltering which was adopted by some settlers of the midwestern plains of the United States during the 19th century.⁴ In China, courtyard-type houses dot the landscape. They were dug into soil to combat hot summers and bitterly cold winters.⁵

The sum and substance of the preceeding discussion is that the use of solar access and earth shelter housing are not recent developments. Each has its own history of development and use. However, since the oil embargo in 1973 and again in 1978, the increasing cost of non-renewable energy sources has caused a resurgent interest in these types of structures in the United States.

C. Current Focus of Energy-Efficient Land-Use

The current focus of energy-efficient land-use can be divided into two categories: energy conservation, and energy conversion. Conservation and conversion opportunities in land-use planning can be grouped into two areas: opportunities for individual building, and opportunities for comprehensive patterns of development.⁶ The following is a list of some of these opportunities identified by the Oregon Department of Energy:^{6,7}

Individual Buildings

1. Increase weatherization of existing structures
2. Increase use of roof overhangs for shading
3. Limit glazed areas
4. Increase use of reflective glazing in commercial and public buildings
5. Reduce commercial lighting use (decorative and advertising)
6. Increase use of landscaping and shading
7. Optimize building orientation on site
8. Increase use of on-site alternative energy sources (solar and wind)
9. Increase use of two story houses
10. Increase use of common walls and cluster houses
11. Increase use of earth sheltering

Comprehensive Patterns of Development

1. Reduce paved area on streets
2. Increase use of bicycle/pedestrian mode
3. Increase use of mass transit
4. Discourage private vehicle use by limiting parking spaces
5. Increase use of mixed, multi-use facilities
6. Locate housing near employment and services
7. Increase building of local recreational facilities
8. Increase use of industrial process heat
9. Increase densities

The strategies identified by Mackie and Mackie⁸ to implement the listed opportunities include zoning ordinances, subdivision regulations, property tax credits, building code amendments, planned unit development ordinances, and municipal capital facilities program. Similar sets of opportunities and strategies have been identified by other agencies including the Minnesota Energy Agency⁶ and the Northeastern Illinois Planning Commission.⁹

During the late 1970's, the American Planning Association prepared two comprehensive documents which address the problems associated with solar access and land use. Site Planning for Solar Access: A Guidebook for Developers and Site Planners was intended to assist developers, site planners and builders in the design of residential developments for solar

access.

The other document, Protective Solar Access for Residential Development: A Guidebook for Planning Officials, was written to show planners how to use conventional land-use controls to protect solar access in new residential development for space heating and cooling and domestic hot water.

The former document, Site Planning for Solar Access, provides guidelines for building orientation on site to minimize shadow interference and to maximize the solar energy absorption through passive and active solar systems. Many types of structures, including a variety of single and multi-family residential structures in various spatial arrangements, have been provided as sample techniques.

Consideration has also been given to use of vegetation and terrain to enhance solar access in site planning. This document suggests two methods by which developers or landowners can protect solar access: restrictive covenants and easements. Each can be used as a strategy to ensure that adjacent landowners do not erect structures or plants and vegetation which would create a negative externality to the property owner.

Protecting Solar Access for Residential Development addresses the legislative opportunities for a community. These include opportunities for planning, zoning, subdivision regulations, regulating trees and landscaping, site plan and environmental review, and restrictive covenants and easements. It is suggested that communities acknowledge the importance of solar access in the comprehensive plan and develop a set of policies which protect solar energy systems.

Zoning for solar access, as presented, requires that a community remove barriers from the existing ordinance (see Section H of this chapter) and then write prescriptive zoning provisions to protect solar access such as height limitations, setback requirements and space requirements. The suggested subdivision regulations for solar access pertain to building orientation, lot orientation, street orientation and street layout to enhance solar access.

Performance standards are also suggested as a possible means of protecting solar access rather than providing specific regulations. By using the performance standards approach, the community allows the developer to use whatever techniques are available to meet the community's standards.

Another valuable tool available to a community is a site plan and environmental review. This allows the community to review development plans to ensure that they conform to community standards for solar access.

D. Federal Legislative Initiatives

During the first session of the Ninety-Fifth Congress, hearings took place before the Subcommittee on the City of the Committee on Banking, Finance and Urban Affairs, House of Representatives.¹⁰ The subject of these hearings was Energy and the City. These hearings included presentations from members of a variety of local, regional, and state planning agencies and research institutes. Many of the testimonies received indicated that aggregate urban energy consumption could be reduced by implementing the various energy-efficiency opportunities identified in the preceding section of this chapter, although

further research was needed to determine the extent of the savings and the cost-effectiveness of each opportunity.

E. Minnesota Initiatives

In 1974, the Minnesota legislature created the Minnesota Energy Agency (MEA).¹¹ The initial responsibilities of the MEA were primarily to provide information and to educate the citizens of the state as to the benefits of voluntary conservation.

The MEA's responsibilities were expanded to include regulatory responsibilities in 1976 and energy grants administration in 1979. In 1980, the Minnesota legislature passed a bill which provided for grants and assistance for community energy planning at the local level. The MEA was directed to administer these additional programs.

With respect to energy-efficient land-use planning, the involvement of the MEA in community energy planning was designed to improve the energy planning capability of local units of government. In conjunction with this effort, two types of grants were provided: 1) community energy planning grants and 2) community energy plan implementation grants.

The purposes of these two grants are described in a Statement of Needs and Reasonableness¹² as follows:

A. Community Energy Planning Grants

Planning grants shall be used for developing local energy plans related to such issues as, but not limited to: citywide or countywide conservation; use of renewable resources through technologies currently available, conservation of energy used in buildings owned by the local unit of government, of energy used for buildings and street lighting, and of energy used in building space heating and cooling; and energy con-

siderations in traffic management, in land-use planning, in capital improvement programming/budgeting, in municipal operating budgets, and in economic development plans.

B. Community Energy Plan Implementation Grants

Implementation grants shall be used for purposes of implementing all or portions of a local community energy plan. Local units of government may apply for implementation grants whether or not the community energy plan was prepared under the Community Energy Planning Grant Program provided the community energy plan has been submitted and approved by the Agency.

The grants program is currently funding planning efforts in a limited number of communities due to limited availability of state funds. The 1982 grants program was allocated \$200,000 which was allocated in individual grants of no greater than \$20,000 per community.¹³

At the encouragement of the MEA and other proponents of energy-efficient land-use, some fundamental changes have been enacted in Minnesota planning laws. The laws pertain to energy planning, solar access, protection of solar rights, and earth-sheltered construction. These changes are found in the Municipal Planning Act,¹⁴ the County Planning Act,¹⁵ the Estates in Real Property Act,¹⁶ and the Metropolitan Government Act.¹⁷

The municipal planning legislation takes the form of permissive legislation which allows the local units of government to perform certain planning tasks. The zoning component of the act allows that a municipality may by ordinance regulate, among other items, the location, height, bulk, and number of stories of buildings. Zoning

may also regulate size of yards and spent spaces, and the density and distribution of population. Each of the regulatory items could be used to promote aggregate community energy efficiency. In addition, a 1978 amendment was attached to the legislation which allows municipalities to regulate access to direct sunlight for solar energy systems. Variances may be applied for by individuals if the zoning ordinance causes undue hardship. Specifically mentioned, an unusual hardship includes inadequate access to direct solar access for solar energy systems. Municipal subdivision regulations may, by state statute, set standards and requirements to address land-use energy efficiency. This includes the planning and design of sites, and access to solar energy.

The county planning act includes provisions for zoning controls of land-use in a predominately agricultural, forested, or open space use. However, in 1978, the Act was amended to specifically include solar considerations. As with the municipal act, the county act is permissive rather than mandatory. It allows the county zoning ordinance to protect and encourage access to direct sunlight for solar energy systems. Variances may be applied for in such cases where the prevailing ordinance causes unusual hardship to an individual. Specifically mentioned, the inability to use solar energy systems may be considered a hardship.

Subdivision 3 of the County Planning Legislation was amended in 1980 to prohibit disallowing earth sheltering. According to this amendment, no provision may prohibit earth sheltered construction as defined in Section 116H.02, Subdivision 3, that complies with all other zoning ordinances promulgated pursuant to this section. In this instance, the amendment is mandatory rather than permissive. Earth shelter cannot be

denied on the basis of zoning. Earth-sheltered, as referenced, means constructed so that more than 50 percent of the exterior surface area of the building, excluding garages or other accessory buildings, is covered with earth and the building code standards promulgated pursuant to Section 16.85 are satisfied; partially completed buildings shall not be considered earth-sheltered.¹⁸

The intent of the earth shelter legislation is to distinguish between earth shelter construction and basement housing. The former is constructed according to code and with generally acceptable aesthetic quality and provides a means for energy conservation. The latter is often a structure used as temporary living quarters until the superstructure is completed. Local objections to the basement dwelling are often with regard to a lack of design for habitation. They generally do not meet code requirements for natural lighting, ventilation, entrances and exits, or egress from bedrooms in case of fire.

At the Metropolitan Government level (Minneapolis-St. Paul Metropolitan Area), there are two recent amendments to the enacted legislation which address the issue of planning for energy-efficient land-use. Both amendments pertain to solar access. The Metropolitan Government is directed to make plans for the physical, social, and economic development of the metropolitan area and to provide guidance for accomplishing the harmonious development of the area. One amendment suggests that such plans may include methods for protection and assuring access to direct sunlight for solar energy systems.¹⁹ The second amendment relates to the land-use plan. It states that a land-use plan shall contain a protection element, as appropriate, for protection and development of access to direct sunlight for solar energy systems.²⁰ It should be

noted that this function is mandated. It requires communities in the metropolitan region to include a solar access element in their comprehensive plans. The strength of this amendment lies in the fact that the Metropolitan Council serves as a review agency for the local community plans. If the local plans do not meet with the requirements of the Metropolitan Council, state and federal revenues directed to the communities can be refused approval. This tends to encourage cooperation of the communities to comply with the metropolitan regulations.

In Minnesota, the state's real estate property laws are explicit with regard to solar access and easements. They specifically define solar easements and the contents thereof. The pertinent sections and subdivisions of the legislation are contained in the following:

500.30 Solar Easements. Subdivision 1. "Solar easement" means a right, whether or not stated in the form of a restriction, easement, covenant, or condition, in any deed, will, or other instrument executed by or behalf of any owner of land or solar skyspace for the purpose of ensuring adequate exposure of a solar energy system as defined in Section 116H.02, subdivision 11, to solar energy.

Subd. 2. Any property owner may grant a solar easement in the same manner and with the same effect as a conveyance of an interest in real property. The easements shall be created in writing and shall be filed, duly recorded, and indexed in the office of the recorder of the county in which the easement is granted. No duly recorded solar easement shall be unenforceable on account of lack of privity of estate or privity of contract; such easements shall run with the land or lands benefited and burdened and shall constitute a perpetual easement, except that a solar easement may terminate upon the conditions stated therein or pursuant to the provisions of section 500.20.

Subd. 3. Any deed, will, or other instrument that creates a solar easement shall include, but the contents are not limited to:

- (a) a description of the real property subject to the solar easement a description of the real property benefiting from the solar easement;

(b) a description of the vertical and horizontal angles, expressed in degrees and measured from the site of the solar energy system, at which the solar easement extends over the real property subject to the solar easement, or any other description which defines the three dimensional space, or the place and times of day in which an obstruction to direct sunlight is prohibited or limited;

(c) any terms or conditions under which the solar easement is granted or may be terminated;

(d) any provisions for compensation of the owner of the real property benefiting from the solar easement in the event of interference with the enjoyment of the solar easement, or compensation of the owner of the real property subject to the solar easement for maintaining the solar easement;

(e) any other provisions necessary or desirable to execute the instrument.

Subd. 4. A solar easement may be enforced by injunction or proceedings in equity or other civil action.

Subd. 5. Any depreciation caused by any solar easement which is imposed upon designated property, but not any appreciation caused by any solar easement which benefits designated property, shall be included in the valuation of the property for property tax purposes.²¹

F. Local Government Efforts

Many cities within Minnesota have taken action to promote energy efficiency within the community. Among these are the cities of Champlin, Minneapolis, and Moorhead. A resolution has been presented to the Champlin City Council to establish a Champlin Energy Commission for the purpose of monitoring data to the community on effective conservation and the efficient use of energy resources, and matters relevant to energy conservation in Champlin.²²

The City of Minneapolis is in the process of preparing an energy component for its Plan for the 1980's. Because it is an older and relatively intensely developed city, it is concentrating on multi-family

housing, weatherization of existing housing stock, and accessibility through public transportation. One stated objective is that the City of Minneapolis should insure that major energy-efficiency improvements are made in all existing housing and assure that new housing be as energy-efficient as possible.²³

The City of Moorhead has adopted a zoning ordinance amendment which exempts solar energy systems from lot coverage restrictions. This city also has a zoning ordinance for planned unit design and solar access. It states:

For purposes of flexibility, uniqueness, innovative design, energy conservation and the encouragement of the use of renewable energy sources, it is hereby established that a modification of yard requirements may be granted if the applicant files and receives approval in accordance with Section 8.00 as it relates to the Conditional Use Permits. The proposal shall meet the following criteria:

- a. The parcel shall be a minimum of one (1) acre in size.
- b. The proposal shall be compatible with adjacent land use.
- c. Minimum side yard requirements of the parent district shall be maintained on its perimeter lot lines when abutting adjacent lots.
- d. The proposal shall not increase the overall density as regulated by the requirements of the parent district, except that a density bonus of 20% may be granted in the R-1 single and limited two family district and R-2 single and two family district for developments that optimize creative and efficient use of land and housing to promote energy conservation and alternative energy sources. Approaches may include active and/or passive solar systems, earth-shelter structures, cluster units of up to four per structure (in the R-1 district), landscaping and energy construction standards that will achieve a heating load of not more than three BTU-s per square foot per degree day per year.²⁴

As is evidenced by the above extraction, Moorhead has essentially

launched a three-pronged effort to achieve energy-efficient land-use: solar access, earth sheltering, and planned unit development. The Moorhead ordinance is thought to be an excellent example of how to incorporate energy efficiency into zoning ordinances. For this reason, it is offered as an example in the Minnesota Energy Agency's Planning Tools Library.

G. Minnesota Community Energy Survey

During the Spring of 1981, the Minnesota Energy Agency conducted a community energy survey to determine energy interests and needs of Minnesota communities. Surveys were mailed to 850 communities which was equivalent to a 100% survey. Of this, a 32.7 percent response rate was generated. The summary of survey results²⁵ was based on those communities which responded. Of those communities responding, 15.1% had energy committees, 43.5% had organized energy activities, and 82.3% indicated a desire for outside assistance with their energy problems. The types of assistance desired included information and education, help in organization, help in energy planning, and help in energy technologies.

Information gathered from this survey indicates that local interest does exist for the promotion of community energy efficiency activities. Particular to this research, there was an interest in energy planning assistance. There was a 46.7 percent response desiring help with this activity.

H. Barriers to Earth-Sheltered Construction and Solar Access

Barriers to earth-sheltered construction and solar access exist despite an apparent increase in interest for these methods of energy conservation. While limited research has been conducted with respect to

barriers to earth-sheltered construction, substantial research has been conducted with respect to solar access.

The Minnesota Energy Agency has identified three barriers to earth-sheltered construction. These include: 1) basement ordinances and definitions of basements and cellars may exclude earth-sheltered construction; 2) interpretation of setback requirements, minimum floor area and lot size requirements, and maximum lot coverage requirements may inhibit earth-sheltered construction; and 3) earth-sheltered construction is a type of construction and not a use, a fact which must be kept in mind when revising zoning ordinances.²⁶ The primary barrier, however, seems to be one of definition as pertaining to acceptable housing standards.

Typically, a city's objection to earth-sheltered housing has been targeted to basement housing, which was not designed for habitation. These structures have often provided inadequate natural light and ventilation. They have only one entrance/exit, and the egresses from bedrooms in case of fire have been non-existent. Another objection has been directed toward the aesthetic quality of the dwellings. To prohibit basement housing, cities have implemented zoning ordinances and other land-use regulations which may also inhibit construction of earth-sheltered buildings.²⁷

As discussed in Section E of this Chapter, earth-sheltered construction cannot be denied on the basis of zoning. A local government must allow earth-sheltered construction as long as it adheres to local building codes. In keeping with the laws, the MEA has recommended that local governments do the following: 1) assess physical barriers to earth-sheltered construction in the community and develop a policy on earth sheltering for inclusion into the comprehensive plan; and 2) re-

view the existing zoning ordinance and remove barriers to earth-sheltered construction, and add language necessary to insure appropriate control of earth-sheltered construction.²⁸

Attention is now turned to solar access barriers. According to a study conducted by the United States Department of Energy in 1979, there are three major barriers to solar energy use. These are: 1) limited public awareness of and confidence in solar technologies; 2) widespread use of solar energy is also hindered by federal and state policies and market imperfections that effectively subsidize competing energy sources (oil and gas price controls), and 3) financial barriers faced by users and small producers are among the most serious obstacles to increased solar energy use (i.e., high initial cost cannot be spread over useful lives).²⁹

Certain land-use restrictions may present barriers to solar access. These barriers have been identified as follows:

1. Land-use restriction barriers
 - a. Height restrictions may require variances.
 - b. Aesthetic regulations may require all structures to be architecturally compatible.
 - c. Detached solar collector units may not comply with setback requirements or a percent of land covered by structures may be exceeded.
 - d. Lot line angle requirements may not allow maximum solar orientation.

2. Nuisance law

Nuisance law examines the reasonableness of a particular land use in relation to surrounding land uses. There are two conceivable ways in which a solar collector could be considered a nuisance. The first would be where a collector is perceived by surrounding land owners as an aesthetic nuisance. Another conceivable nuisance theory would claim that a collector is

producing excessive³⁰ glare and is discomforting neighboring landowners.

Solar access law has been studied extensively as a result of research sponsored by the U. S. Department of Housing and Urban Development in cooperation with the U. S. Department of Energy. Two of the important conclusions from this study relate to legal barriers to solar access. These are: 1) there is no single "ideal" solar access law since different communities or parts of communities may need different legal approaches, and 2) poorly conceived solar access laws could have adverse effects on development patterns, property values, and public attitudes toward solar energy.³¹ This increases the difficulty of drafting appropriate amendments to local zoning ordinances.

One problem with drafting an appropriate solar access law pertains to externalities which might be created. Solar access could adversely impact adjacent lots if they were granted solar access protection. On the other hand, special permits could be used to protect the permitted use from activities on adjacent land. The whole issue revolves around who is casting a shadow on whom. Consequently, the major legal constraints on solar access law are, in order of importance: the constitutional requirements of public purpose, of equal protection, and of payment of compensation if property is so severely regulated that due process requirements are violated.³²

Even if a community is successful at drafting and adopting solar access legislation, barriers to implementation still exist. There is an apparent delay or time lag by as much as ten years before: 1) solar access is adopted by residential and commercial development industries, 2) public and local government acceptance of new aesthetic standards, and 3)

legal issues of solar access, easements, and use of public lands for solar technology installations are unraveled.³³

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3. Ibid., p.168.
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5. Ibid., p.15.
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16. Estates in Real Property, Solar Easement Legislation, Chapter 500, Minnesota Statutes, 1978.
17. Metropolitan Government, Chapter 473, Minnesota Statutes, 1978.
18. "Minnesota Energy Agency," Minnesota Statutes, Chapter 116H.02, Subdivision 3.
19. Metropolitan Government Act, Chapter 473, Minnesota Statutes, Section 473.05, Subdivision 1.
20. Ibid., Section 473.859, Subdivision 2.
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24. Op. Cit., p.8.8.
25. Minnesota Energy Agency, "Results of the Minnesota Community Energy Survey," April 13, 1981.
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29. U.S. Department of Energy, Domestic Policy Review of Solar Energy, A response memorandum to the President of the United States, TID-22834, February, 1979.
30. Paul Spivak, Land Use Barriers and Incentives to the Use of Solar Energy, Solar Energy Research Institute, Golden, Colorado, August, 1979, pp.3-4.

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CHAPTER III

METHODOLOGY

A. General Outline

This investigation was divided into three sub-problems related to the hypothesis. The first sub-problem relates to the historic development of energy legislation in the state of Minnesota. The second sub-problem was to identify legislation pertinent to this research. The third sub-problem was to identify the degree to which this legislation is implemented at local levels of government. A thorough investigation of each of these sub-problems served to provide information related to the effectiveness of state planning legislation as it pertains to energy efficiency of land-use.

B. Sub-Problem Number 1.

The purpose of sub-problem number 1 was to survey the origins of early development of state energy-related land-use legislation. The solution of this sub-problem has been incorporated into Chapter Two and has provided the background against which the state energy-related land-use legislation was studied. Descriptive data related to the origins, objectives, and development of the said legislation have been collected and analyzed. Sources of data included books, periodicals, scholarly journals, and interviews devoted either in whole or in part to a consideration of state energy-related land-use legislation. These sources were selected so as to include the writings of a widely diversified group of authorities.

The collection of data was analyzed for information applicable to

this study. The synthesis of data followed a topical but chronological order. Preliminary research indicated the following topics be used for guides in the collection and synthesis of the data:

1. A brief history of energy concerns in land-use.
 - a. Early settlement patterns
 - b. U. S. concern, pre-1973
 - c. U. S. concern, post-1973
 - d. Minnesota energy concerns related to land-use
2. Energy Strategies of Land-use and Energy Conservation and Production
 - a. Federal
 - b. Other states
 - c. Minnesota

C. Sub-Problem Number 2.

The purpose of sub-problem number 2 was to identify Minnesota legislation directed towards energy-related land-use policies. The solution of this sub-problem was central to the exploration of the hypothesis. It was the identified legislation which was analyzed and determined effective or ineffective in achieving the desired result. The kind of data which was retrieved for this sub-problem included Minnesota legislative acts pertaining to energy-related land-use policies. The sources for this data were the Minnesota Statutes and policies of the Minnesota Energy Agency. Each legislative act pertaining to energy-related land-use policies was identified and those portions of each act directly related to the proposed research were outlined. The following topics served as guides in the collection and synthesis of data:

1. Municipal Planning Acts
2. County Planning Acts
3. Regional Development Acts
4. Metropolitan Government Acts
5. Solar Access Legislation
6. Earth Shelter Construction Legislation
7. Building Orientation
8. Land Development Patterns

D. Sub-Problem Number 3.

The purpose of sub-problem number 3 was to analyze the implementation of Minnesota energy-related land-use legislation by local units of government. These local levels of government included city and county governments. By solving this sub-problem, it was possible to assess the effectiveness of state energy policies as they applied to local governments. The kinds of data retrieved for sub-problem number 3 included specific information from a variety of communities throughout the state. This included information regarding the incorporation of the state's enabling legislation into local zoning ordinances, sub-division regulations, and land-use plans. This information was collected by using a random sample survey of city and county governments throughout the state. Sample size was determined through the use of appropriate statistical methods. Each local government which was selected for this research was surveyed by telephone interview.

E. Informational Needs and Survey Development

The first step in the survey research process was to identify information needs. Informational parameters were determined according to the

particular opportunities provided by related state legislation to local units of government. For instance, the zoning component of the Municipal Planning Act allows a municipality to regulate access to direct sunlight for solar energy systems. Hence, question number 8 of the survey (Table 3-1) was included. Questions 8 through 14 of the survey directly relate to Minnesota legislation, of which advantage can be taken by local governments to improve energy efficiency.

1978 was the year in which the Municipal and County Planning Acts were amended to allow for energy-efficient opportunities in land-use controls. For this reason, question number 7 was included in the survey to separate local governments into groups which have updated zoning ordinances since 1978 and those which have not. By doing so, it was possible to identify which communities have had the formal opportunity to incorporate the allowed changes in zoning ordinances and those which have not. The purpose for doing this, was to determine the proportion of communities which could have implemented the change but failed to do so.

No question specifically addresses the land-use plan amendment of the Metropolitan Government Act which mandated solar access protection, although information needed to evaluate compliance is requested in question 11. Information from question 11 was sought for local governments statewide. Information specific to this amendment was extrapolated from surveyed municipalities located within the Metropolitan region.

Information was also needed to assess the effectiveness of the MEA's Community Energy Planning Grants in stimulating energy planning activities at the local level. Questions 12 and 13 addressed this need by providing information to determine the extent to which local governments have applied for and received energy planning or implementation grants.

Table 3-1

COMMUNITY ENERGY LEGISLATION SURVEY

1. Name of city (county)? _____
2. Population (1980 census)? _____
3. Name of contact? _____
4. Title or position of contact? _____
5. Telephone number of contact? () _____
6. Business address? _____
7. Has the city's (county's) zoning ordinance been updated since 1978? Yes _____ No _____
8. Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems? Yes _____ No _____
9. Does the existing zoning ordinance prohibit the construction of earth-sheltered structures? Yes _____ No _____
10. Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing? Yes _____ No _____
11. Does the city's (county's) comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems? Yes _____ No _____
12. Has the city (county) applied for a Community Energy Planning Grant from the Minnesota Energy Agency? Yes _____ No _____
13. Has the city (county) received a Community Energy Planning Grant from the Minnesota Energy Agency? Yes _____ No _____
14. Does the city's (county's) subdivision regulations include standards and requirements for solar access? Yes _____ No _____

Date survey taken _____

Questions 7 through 14 were designed to elicit a yes or no response from the individual being surveyed. It was reasoned by the author that a nominal response of this nature would be sufficient to determine action or no action on the given legislative opportunity. The proportioned action or inaction, as the case may be, would serve as a basis for evaluation of legislative effectiveness.

F. Sample Selection

Research data was required from two separate populations. The first set included the population comprised of all counties in the state. The total population of this set was 83 counties. The second set included the population of cities within the state with a population greater than 1000. This population set included 313 cities.

Resource limitations prohibited a 100 percent survey of each population. Therefore, sampling techniques were employed for each population set. In each case, a modified random sampling technique was used to insure sampling from a broad range of county and city population sizes. In each case, a list of all elements (counties and cities) was acquired for the respective set. The counties and cities were then ranked in an order from least populated to most populated.

The next decision was to determine the appropriate sampling technique. A factor in determining the technique was the broad spectrum of populations for individual counties and cities. It was decided that a sample of counties should include a complete population range. The sample of cities, however, should be limited to those cities over 1000, while still including a complete range of cities with populations greater than 1000. The reason for not including cities with populations less

than 1000 was because zoning and planning efforts in these communities is generally limited or else handled by the county in which the city is located.

A systematic sampling technique¹ provided a vehicle for ensuring the desired distribution of county and city populations within the respective sample sets. This was accomplished by taking every Kth element from the respective ranked lists of counties and cities. The Kth element was determined by the sample size necessary from each list. The starting point for selecting the first sample was taken from a table of random digits.²

The systematic sampling technique was employed as described for the survey of cities. This method was used in combination with a stratified sampling technique³ to ensure that larger cities were included in the sample. This was necessary since there were relatively few larger cities (cities with populations greater than or equal to 10,000) compared to the number of smaller cities (1,000 to 9,999). The selected strata included cities within the following population limits: a) 1,000 to 9,999, b) 10,000 to 89,999, and c) 90,000 plus. The sizes of the respective strata were: a) 247, b) 53, and c) 3.

The selection of limits for the designated strata was based on certain commonalities of communities within each strata. The smaller cities with populations between 1,000 and 9,999 tended to be rural service communities. The mid-size cities with populations between 10,000 and 89,999 tended to be suburban communities near larger central cities. The largest cities, with populations of 90,000 or more, were central cities. There was some overlap in the categories but it was not believed to be critical to the outcome of the survey. For instance, some

cities within the mid-size group were actually freestanding central cities rather than suburban cities.

G. Sample Size

The sample size of surveyed population was determined so as to ensure a reasonable degree of accuracy between the sample results and the true proportions if a 100 percent sample was conducted. The confidence interval and the confidence level of a .10 and 95 percent, respectively, were selected by the author as acceptable limits for this procedure. The formula used to determine the sample size has a reduction factor built into it to account for a small total. The formula is:^{4,5}

$$n = \frac{N}{1 + N(e)^2}$$

where:

n = sample size

N = total number of cities or counties in the stratification

e = confidence interval

Based on this formula, the following sample sizes were determined for:

1. County sample size, N=87

$$n = \frac{87}{1+87(.1)^2} = 47, \text{ or } 54\% \text{ of total population}$$

2. Small size cities (population 1,000 - 9,999), N=247

$$n = \frac{247}{1+247(.1)^2} = 71, \text{ or } 29\% \text{ of strata}$$

3. Mid-size cities (population 10,000 - 89,999), N=63

$$n = \frac{63}{1+63(.1)^2} = 39, \text{ or } 61\% \text{ of strata}$$

4. Large size cities (population 90,000+), N=3

$$n = \frac{3}{1+3(.1)^2} = 2.9 \text{ or } 100\% \text{ of strata}$$

As should be expected, the percent of samples needed (with respect to total elements [N] within a strata) increases as strata size decreases.

H. Survey Technique

The options available for conducting the survey included: 1) mail survey, 2) personal interview, and 3) telephone interview. Mail survey was rejected because of the typically low response rate associated with this technique. Personal interview was rejected due to the large geographic area which the survey was to cover and the high cost associated with the travel necessary to complete the survey. Telephone interview was selected as the survey technique because it combined the benefits of a high response rate, acceptable cost, ease of execution, and rapid response.

I. Compilation of Results

The survey results were compiled according to five categories: 1) county, 2) small size cities, 3) mid-size cities, 4) large size cities, and 5) cities within the Twin Cities Metropolitan Region. The results for each compilation are presented in the next chapter.

J. Treatment of Data

Within each of the specified categories, each question was analyzed by inspection of the number of positive and negative responses and the proportionate response. This provided indication of the categorical adaptation of the pertinent legislation associated with the respective questions. Questions 8, 9, and 10 were then analyzed to discern the relationship of each to question 7. The purpose here was to determine if the 1978 zoning legislation did, in fact, contribute to the adoption of available legislative mechanisms at the local level. If the state legislation passed in 1978 was effective, then a zoning update later than 1978 would yield a positive response to questions 8, 9, and 10. The chi-square

test was used to determine variable relatedness.

The chi-square test is a very general test which can be used to evaluate whether or not frequencies which have been empirically obtained differ significantly from those which would be expected under a certain set of theoretical assumptions.⁶ The procedures used for applying the chi-square test are as follows:

1. Determine r categories using nominal scale for the first variable being related and c categories for the second variable. Then collect sample size N and distribute among the cells of the r by c contingency table. (In this case, the sample size was predetermined by the method outlined in Section G of this chapter. The contingency table in each case was a 2×2 matrix.)
2. Determine the critical value of $X_{\star}^2$:
 - a) State level of significance ($=.05$)
 - b) Obtain degrees of freedom
 $df = (r-1)(c-1) = (2-1)(2-1) = 1$
 - c) Identify the critical value of $X_{\star}^2$ in a table of X^2 distribution
 $X_{\star}^2 = 3.841$
3. Calculate the observed value of X^2 :

$$X^2 = N \sum_{i=1}^r \sum_{j=1}^c \frac{(n_{ij} - \frac{n_{i.}n_{.j}}{N})^2}{\frac{n_{i.}n_{.j}}{N}}$$

4. Assume hypothesis of independence (i.e., no relationship among variables).

Then:

if $X^2 > X_{\star}^2$, reject hypothesis

if $X^2 \leq X_{\star}^2$, do not reject⁷

References to Chapter III

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5. This formula makes use of a conservative approach by setting $e = .1$ and $Z = 2.00$. See Krueckenberg, p.115.
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7. Krueckenberg and Silvers, pp.143-144.

CHAPTER IV

SURVEY RESULTS

A. Introduction

The results of data collected by telephone survey were separated into two primary categories for purposes of analysis and discussion. The two categories are: 1) county data and 2) municipal data. The municipal data was further separated into three subcategories according to the stratifications described in Section F of Chapter III. The purpose of this chapter is to summarize the survey results according to the respective categories.

B. County Survey Results

County surveys were conducted by attempting to contact the county zoning administrator or county planner. Of the 47 counties surveyed, the respondents were one of these officials in 43 of the counties, while a county commissioner was the respondent from one county. Officials from three counties were unavailable, thus resulting in no response from those counties. The rate of respondents from the survey was 93.4 percent. Figure 4-1 displays the geographic distribution of the responding counties. The following is a summary of responses for questions 7 through 14.

Question 7: Has the county's zoning ordinance been updated since 1978? 59% of the respondents indicated that the county ordinance had been updated since 1978, and 20% indicated that it had not. Two counties (5%) had no zoning ordinance and seven counties had shoreline and flood-plain zoning only.

Question 8: Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems? Of the 44 respondents, 11.4 percent indicated yes, while 68.2% indicated no to this question. The remaining 20.4 percent had no zoning ordinance or only shoreline and floodplain zoning.

Question 9: Does the existing zoning ordinance prohibit the construction of earth-sheltered structures? Only one county (2.3%) indicated yes to this question, while 77.3 percent indicated no. The remaining 20.4 percent were those with no zoning ordinance or shoreline and floodplain zoning.

Question 10: Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing? 13.6% of the respondents said their zoning ordinance made the distinction, while 66.0 percent did not. Again, the remaining 20.4 percent had no zoning ordinance or only shoreline and floodplain zoning.

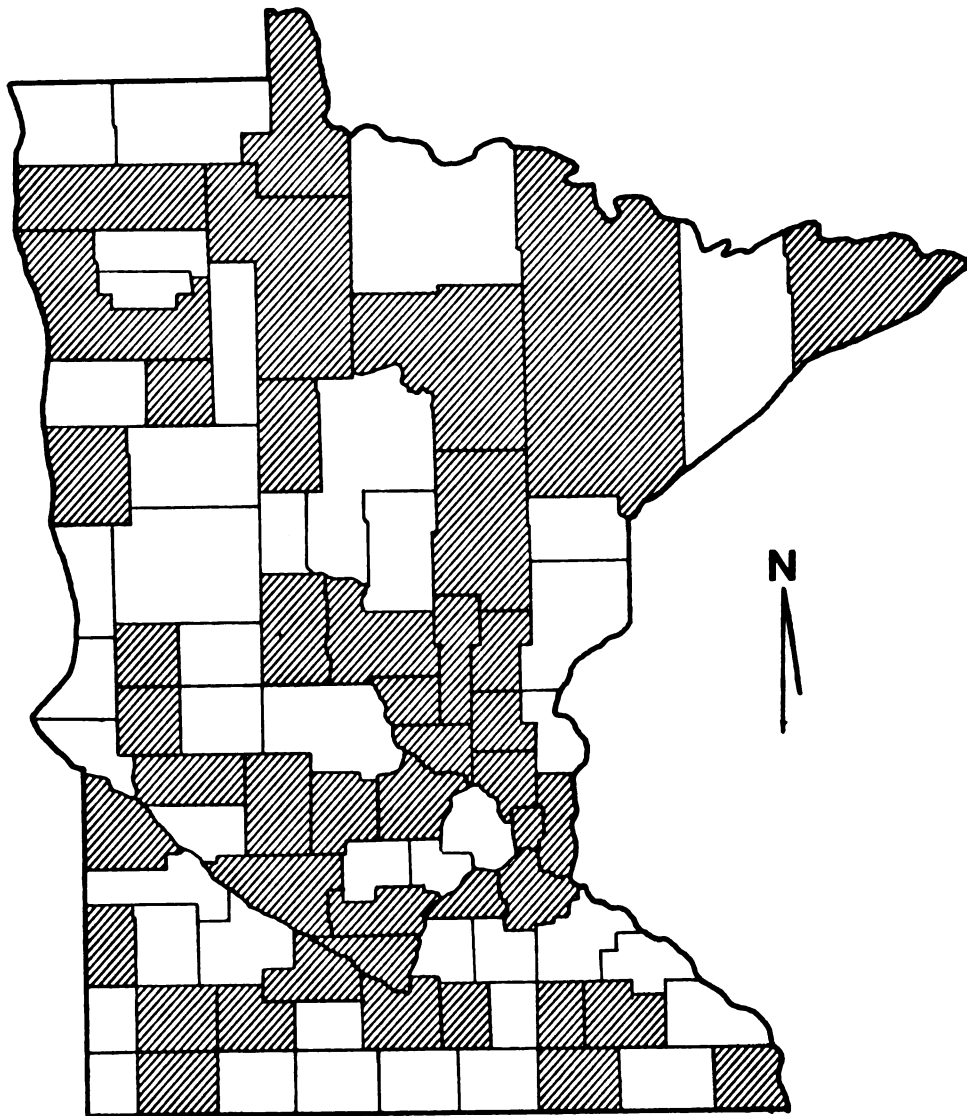
Question 11: Does the county's comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems? 9.1% responded yes to this question and 70.5 percent responded no. The remaining 20.4% of the counties had no comprehensive plan.

Question 12: Has the county applied for a Community Energy Planning Grant from the Minnesota Energy Agency? Only two counties (4.5 percent) applied for a grant, while the remaining 95.5% of the counties had not.

Question 13: Has the county received a Community Energy Planning Grant from the Minnesota Energy Agency? Only one county indicated that it had received a grant and that was in conjunction with one of the muni-

Figure 4-1

GEOGRAPHIC DISTRIBUTION OF COUNTIES
WHICH WERE SURVEYED



Counties which were surveyed

cipalities in the county. None of the remaining counties (97.7%) had received such a grant.

Question 14: Does the county's subdivision regulations include standards and requirements for solar access? Three counties (6.8 percent) responded yes to this question and 81.8 percent responded no. Subdivision regulations were non-existent in 11.4% of the counties.

C. Municipalities with Populations from 1,000 to 9,999

There were 71 telephone surveys (29% of all cities in this population range) attempted for this strata. A total of 65 responses (91.5%) were collected. The following is a summary of responses received for this strata.

Question 7: 56.9 percent of these cities have updated their zoning ordinances, while 4.0 percent have not. Only 3.1% indicated that their city had no zoning ordinance.

Question 8: The existing zoning ordinance in 9.2% of the cities provided for the protection and encouragement of solar access, while 86.2 percent did not. One city (1.5%) indicated that it provided for solar access indirectly.

Question 9: The zoning ordinance in two cities (3.1 percent) prohibit the construction of earth-sheltered structures, while 93.8% do not.

Question 10: Four city zoning ordinances (6.2 percent) distinguish between earth-sheltered housing and basement housing and 90.7 percent do not make this distinction.

Question 11: The comprehensive land-use plan in 15.4% of the cities provides for the protection and development of solar access. 77 percent of the plans do not provide for this.

Question 12: Only five (7.7 percent) of the cities have applied for Community Energy Planning Grants from the Minnesota Energy Agency. The remaining 92.3 percent have not applied for a planning grant.

Question 13: Four cities (6.2%) received Community Energy Planning Grants from the MEA, while 93.8 percent had not.

Question 14: Three cities (4.6 percent) had subdivision regulations which included standards and requirements for solar access, while 93.8% did not. One city did not have a set of subdivision regulations.

D. Municipalities with a Population from 10,000 to 89,999

There were 39 telephone surveys (61 percent of all cities in this population range) attempted for this strata. A total of 38 responses (97.4%) were collected. The following is a summary of responses received for this strata.

Question 7: Of the 38 respondents 24 (63.2 percent) of the cities have updated their zoning ordinances since 1978 and 14 (36.8 percent) have not.

Question 8: Five cities (13.2 percent) have zoning ordinances which provide for the protection and encouragement of solar access, while 33 (86.8 percent) do not.

Question 9: Only one (2.6 percent) city's zoning ordinance prohibits the construction of earth-sheltered structures, while 37 (97.4%) do not.

Question 10: Five (13.2 percent) city zoning ordinances distinguish between earth-sheltered housing and base housing, while 33 (86.8 percent) do not.

Question 11: Fifteen (39.5 percent) of the cities have comprehensive land-use plans which contain an element for the protection and develop-

ment of solar access, while 23 (60.5 percent) do not.

Question 12: One (2.6%) city has applied for a Community Energy Planning Grant from the Minnesota Energy Agency. The remaining 37 (97.4 percent) have not.

Question 13: No cities in this strata have received a Community Energy Planning grant from the Minnesota Energy Agency.

Question 14: Two (5.3%) of the cities' subdivision regulations include standards and requirements for solar access, while 36 (94.7 percent) do not.

E. Municipalities with a Population Greater Than 90,000

There were three telephone surveys (100 percent of all cities in this population range) attempted for this strata. A total of two responses (66.7 percent) were collected. The following is a summary of responses received for this strata:

Question 7: The zoning ordinances of both cities (100 percent) have been updated since 1978.

Question 8: The zoning ordinances of both (100 percent) cities provide for the protection and encouragement of solar access.

Question 9: The zoning ordinance of neither (0.0 percent) prohibits the construction of earth-shelter structures.

Question 10: One (50 percent) of the cities' zoning ordinances distinguish between earth-sheltered housing and basement housing, while one (50%) does not.

Question 11: One (50 percent) of the cities' comprehensive land-use plans contains an element for the protection and development of solar access, while one (50 percent) does not.

Question 12: One (50 percent) city has applied for a Community Energy Planning Grant from the Minnesota Energy Agency, while one (50 percent) has not.

Question 13: One (50 percent) city has received a Community Energy Planning Grant, while one (50 percent) has not.

Question 14: Both (100 percent) cities' subdivision regulations include standards and requirements for solar access.

F. Municipalities within the Twin Cities Metropolitan Region

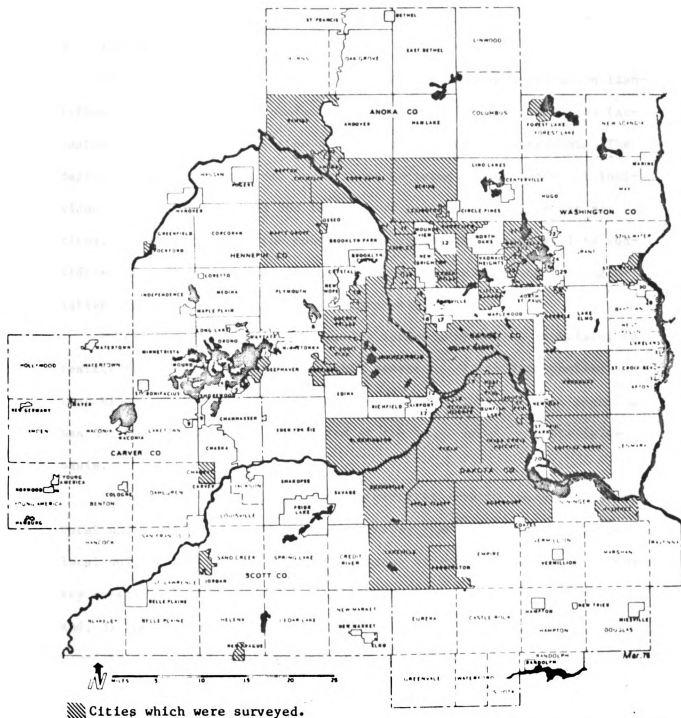
Of all the cities surveyed, 46 were located within the Twin Cities Metropolitan Region. Figure 4-2 displays the geographic distribution of sample cities within this region.

Question 11 pertains to a specific charge by the state to cities within this region. Therefore, the results of this question were separated into two categories for purposes of studying the effects of said charge. These categories were: 1) respondents from within the metropolitan region and 2) respondents from outside the metropolitan region. A comparative analysis of the two categories was then performed.

Question 11: A response was received from 45 of the 46 cities surveyed within the Twin Cities Metropolitan Region. Of the respondent cities, 23 (51.1 percent) had comprehensive land-use plans containing an element for the protection and development of solar access. Of the responding nonmetropolitan cities, three (5.6 percent) responded positively, while 49 (88.7 percent) responded negatively.

Figure 4-2

**GEOGRAPHIC DISTRIBUTION OF SAMPLE
CITIES WITHIN THE TWIN CITIES METROPOLITAN REGION
WHICH WERE SURVEYED**



- | | | | |
|------------------|---------------------|-------------------|---------------------|
| 1 SPRING PARK | 9 VICTORIA | 17 FALCON HEIGHTS | 26 NEW LANE |
| 2 SHOOB | 10 FOREBURNABLE | 18 NEENAH | 27 WILKINSON |
| 3 SHOOTING BEACH | 11 SPRING LAKE PARK | 19 LITTLE | 28 WHITE BEAR |
| 4 SHOOTING BEACH | 12 W. H. BAY | 20 LITTLE LANE | 29 BEAVER |
| 5 SHELBY | 13 MILLTAP | 21 LEBANON | 30 WILSON |
| 6 SHERBORN | 14 LINCOLN HEIGHTS | 22 BELLEVILLE | 31 NEW PARK HEIGHTS |
| 7 WOODLAND | 15 ST. LOUIS | 23 PINE SPRING | 32 LAKELAND SQUARE |
| 8 WEDGEMORE | 16 LAKESIDE | 24 WATKINS | |

ANOKA— County Boundary
SESS— Municipal Boundary
CHOW— Township Boundary

CHAPTER V

INTERPRETATION OF RESULTS

A. Introduction

The effectiveness of state energy-related land-use legislation identified in Chapter II is dependent upon the degree of implementation (acceptability) of the legislation at the local levels of government. The degree of implementation can be reviewed in terms of the number of individual legislative actions and in terms of collective legislative actions. In this chapter, the county and various city strata will be considered according to total response and proportional response of legislative actions, individually and collectively.

Prior to the discussion of results interpretation, it is helpful to restate the central hypothesis of this research. It is hypothesized that Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the local level on a statewide basis.

The criteria used for determining effectiveness is based on: 1) the total number of positive responses to survey questions 8 through 14 per local unit of government, 2) the percentage of positive responses to survey questions 8 through 14 for each of the county and city groupings, and, 3) the chi-square relationship of questions 8 through 10 as compared to question 7 (zoning ordinance update since 1978). Each of the criteria were assigned values for purposes of evaluating implementation effectiveness. The standards of effectiveness for the respective criteria were as follows for:

1. The total number of positive responses to survey questions 8 through 14 per local unit of government;
 - a. 0 or 1 positive response = ineffective implementation
 - b. 2 or 3 positive responses = marginally effective implementation
 - c. 4, 5, 6, or 7 positive responses = effective implementation
2. The percentage of positive responses to survey questions 8 through 14 for each of the county or city groupings;
 - a. less than 25 percent = ineffective implementation
 - b. 25 to 50 percent = marginally ineffective implementation
 - c. greater than 50 percent = effective implementation
3. The chi-square relationship of questions 8 through 10 to question 7;
 - a. if the observed chi-square statistic is greater than the critical value of chi-square (determined to be 3.841), reject the hypothesis of variable independence = effective implementation
 - b. if the observed chi-square statistic is less than or equal to the critical value of chi-square (3.841), do not reject the hypothesis of variable independence = ineffective implementation

It is noted that the sample size was determined for each strata based on a confidence interval of 0.10 and a confidence level of 95 percent. The reader should refer to Chapter III, Section G, for details pertaining to sample size. Again, the sample size of surveyed population was determined to ensure a reasonable degree of accuracy between the sample results and the true proportion if a 100 percent sample was conducted.

B. County Implementation

The total number of positive responses to questions 8 through 14 per local unit of government is displayed in the scatter diagram according to the population of the responding county (Figures 5-1a and b). Of the 44 responding counties, only one county had enough positive responses to be

Figure 5-1a

County Data Summary
Number of Positive Responses
to Survey
(Questions 8 to 14)

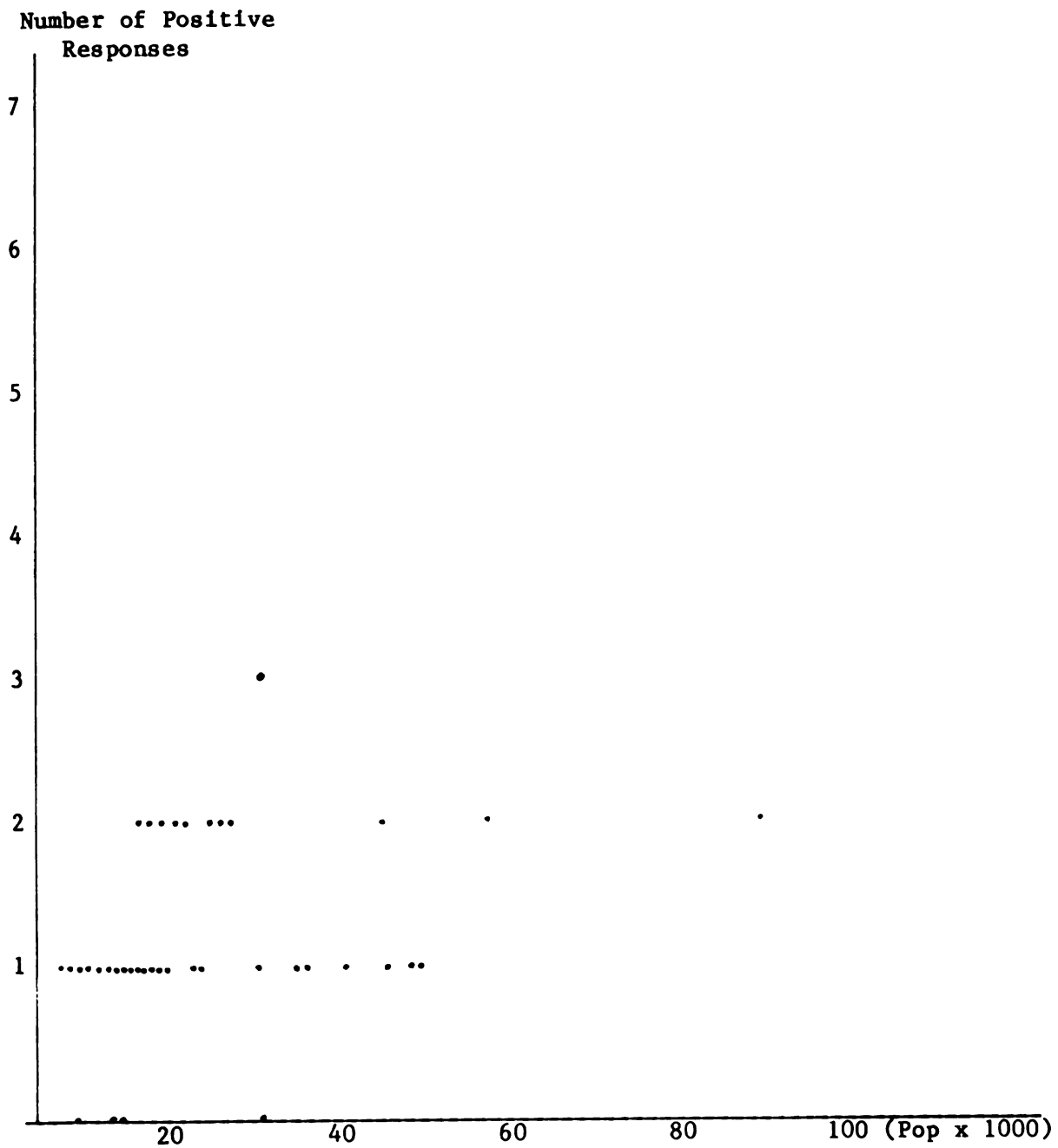
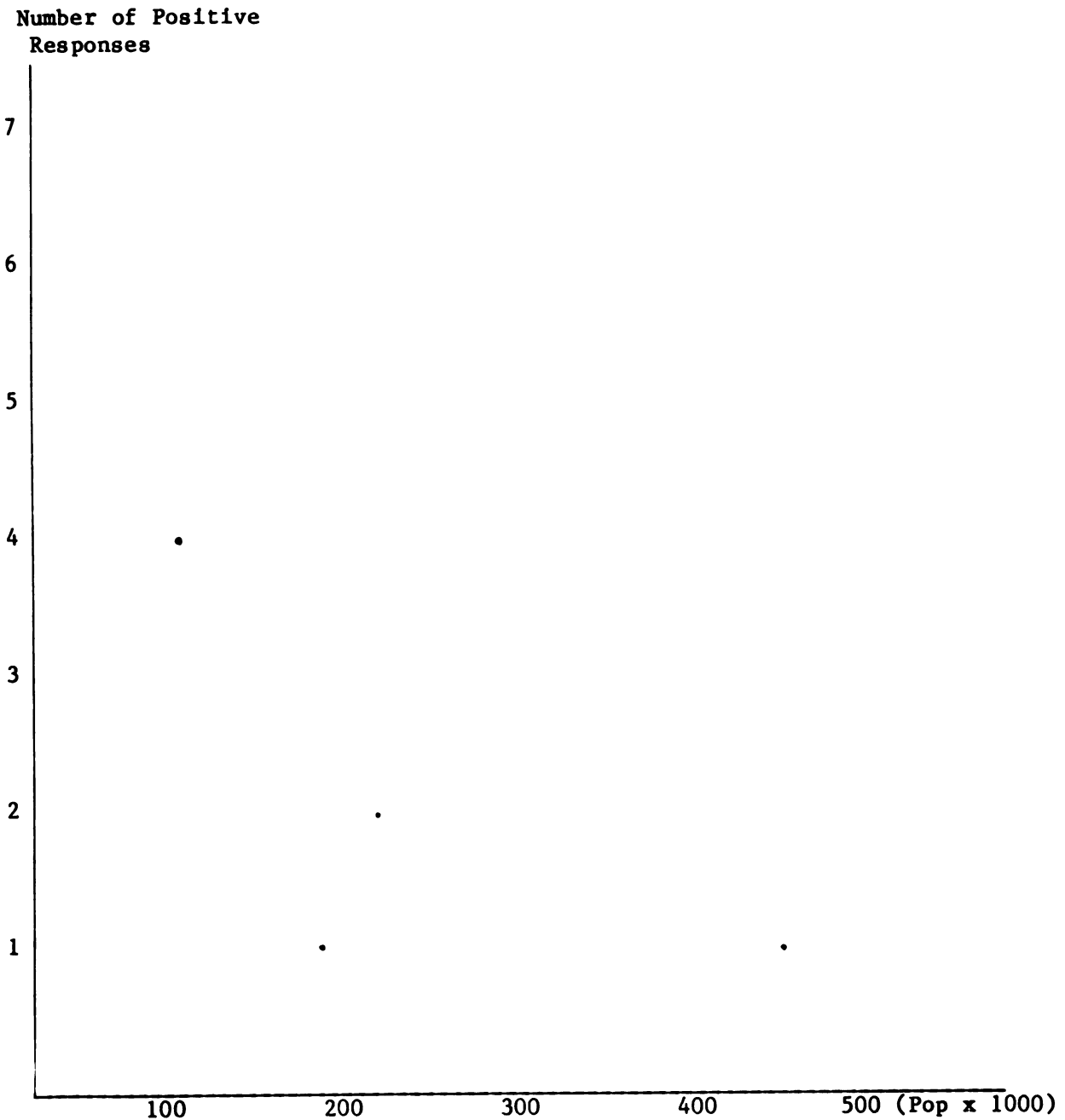


Figure 5-1b

County Data Summary
Number of Positive Responses
to Survey
(Questions 8 to 14)



classified as effectively implementing the legislative opportunities. Twelve counties responded positively to two questions; thus, 13 counties were marginally effective at implementing the legislative opportunities. The remaining 29 counties had 0 or 1 positive responses and were determined ineffective at implementing the legislative opportunities. Of the 44 counties, 65.9 percent were ineffective and 95.5 percent were classified as ineffective or marginally ineffective.

The percent of positive county response to survey questions 8 through 14 is summarized in Table 5-1. For six of the seven questions, a positive response was received less than 25 percent of the time. This interpreted as ineffective implementation of the legislative opportunities. Only one question (question 9) yielded a positive response greater than 50 percent. In 77.3 percent of the counties, it was indicated that the existing county zoning ordinances did not prohibit the construction of earth-sheltered structures. It is noted that a "no" response to this question was interpreted as a positive response.

The chi-square test was used to determine if a relationship existed between the results of the questions pertaining to the county zoning ordinance (questions 8, 9, and 10) and zoning updates since 1978. The purpose of this was to see if the county governments had taken advantage of the respective legislative opportunities when updating zoning ordinances. As expected, the results of questions 8 and 10 were found to be independent of the responses to question 7. That is, a zoning ordinance update since 1978 was not effective at implementing solar access legislation or distinguishing between earth-shelter housing and basement housing. The results of question 9 were also found to be unrelated to the results of question 7. This suggests that county zoning ordinances did

Table 5-1

Percent of Positive County Responses to Survey Questions		
Question	Percent of Positive Responses	Effectiveness of Implementation
8. Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems?	11.4	Ineffective
9. Does the existing zoning ordinance prohibit the construction of earth-sheltered structures. (A "no" response is considered positive.)	77.3	Effective
10. Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing?	13.6	Ineffective
11. Does the city's (county's) comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems?	4.1	Ineffective
12. Has the city (county) applied for a Community Energy Planning Grant from the Minnesota Energy Agency?	4.5	Ineffective
13. Has the city (county) received a Community Energy Planning Grant from the Minnesota Energy Agency?	2.3	Ineffective
14. Does the city's (county's) subdivision regulations include standards and requirements for solar access?	6.8	Ineffective

Table 5-2

SUMMARY OF CHI-SQUARE TEST FOR COUNTY DATA						
Zoning Update Since 1978	Response to Question					
	8		9*		10	
	Yes	No	Yes	No	Yes	No
Yes	6	17	22	1	6	17
No	0	28	11	0	1	10
Chi-Square	3.75		.866		1.290	
Critical Value of Chi-Square	3.841		3.841		3.841	
Reject Hypothesis of Variable Independence	No		No		No	

*Note: A "no" response to question number 9 is interpreted as a positive response.

not prohibit the construction of earth-sheltered construction regardless of zoning updates since 1978.

The conclusion derived from these results is do not reject the hypothesis with respect to county implementation of the respective state legislative opportunities. Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the county level on a statewide basis.

C. Implementation by Small Size Cities (Population 1,000 - 9,999)

The total number of positive responses to questions 8 through 14 per local unit of government for small cities is displayed in the scatter diagram according to the population of the responding city (Figure 5-2). Of the 65 responding cities, three cities had enough positive responses to be classified as effectively implementing the legislative opportunities. Five cities responded positively to three questions and ten cities responded positively to two questions. Thus, fifteen cities are marginally effective at implementing the legislative opportunities. The remaining 47 cities had 0 or 1 positive responses and are determined to be ineffective at implementing the legislative opportunities. Of the 65 cities, 72.3 percent were ineffective and 95.4 percent were classified as ineffective or marginally effective.

The percent of positive responses to survey questions 8 through 14 is summarized in Table 5-3. As with the counties, a positive response was received for six of seven questions less than 25 percent of the time. This is interpreted as ineffective implementation of the legislative opportunities. One question (question 9) yielded a positive response greater than 50 percent. In 93.8 percent of small cities, it was

Figure 5-2

Number of Positive Responses
by City Population (1,000 to 9,999)
(Questions 8 to 14)

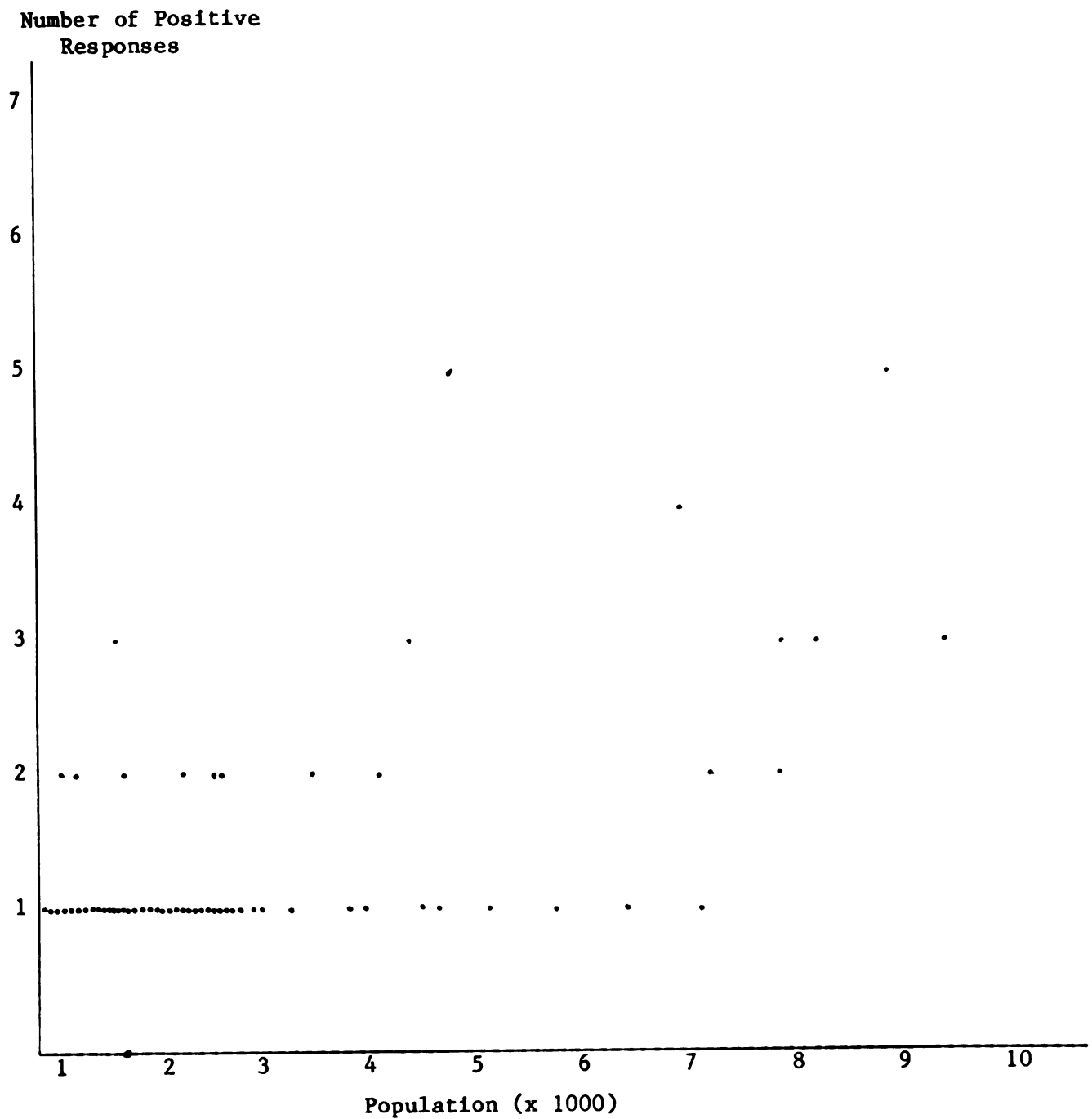


Table 5-3

Percent of Positive Small City Responses to Survey Questions		
Question	Percent of Positive Responses	Effective-ness of Im-plementation
8. Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems?	9.2	Ineffective
9. Does the existing zoning ordinance prohibit the construction of earth-sheltered structures. (A "no" response is considered positive.)	93.8	Effective
10. Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing?	6.2	Ineffective
11. Does the city's (county's) comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems?	15.4	Ineffective
12. Has the city (county) applied for a Community Energy Planning Grant from the Minnesota Energy Agency?	7.7	Ineffective
13. Has the city (county) received a Community Energy Planning Grant from the Minnesota Energy Agency?	6.2	Ineffective
14. Does the city's (county's) subdivision regulations include standards and requirements for solar access?	4.6	Ineffective

indicated that the existing city zoning ordinances did not prohibit the construction of earth-sheltered structures.

The chi-square test was used to determine if a relationship existed between the results of the questions pertaining to the small city zoning ordinances (questions 8, 9, and 10) and zoning updates since 1978. The purpose of this was to see if the small city governments had take advantage of the respective legislation opportunities when updating zoning ordinances. The results (Table 5-4) of this test were similar to the respective county results. The results of questions 8, 9, and 10 were found to be unrelated to the results of question 7. A zoning ordinance update was not related to implementation of solar access legislation, not prohibiting the construction of earth-sheltered construction, and distinguishing between earth-sheltered housing and basement housing. This suggests that zoning ordinance updates since 1978 were not effective at implementing the related legislative opportunities.

The conclusion derived from these results is to not reject the hypothesis with respect to small city implementation of the respective state legislative opportunities. Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the small city level on a statewide basis.

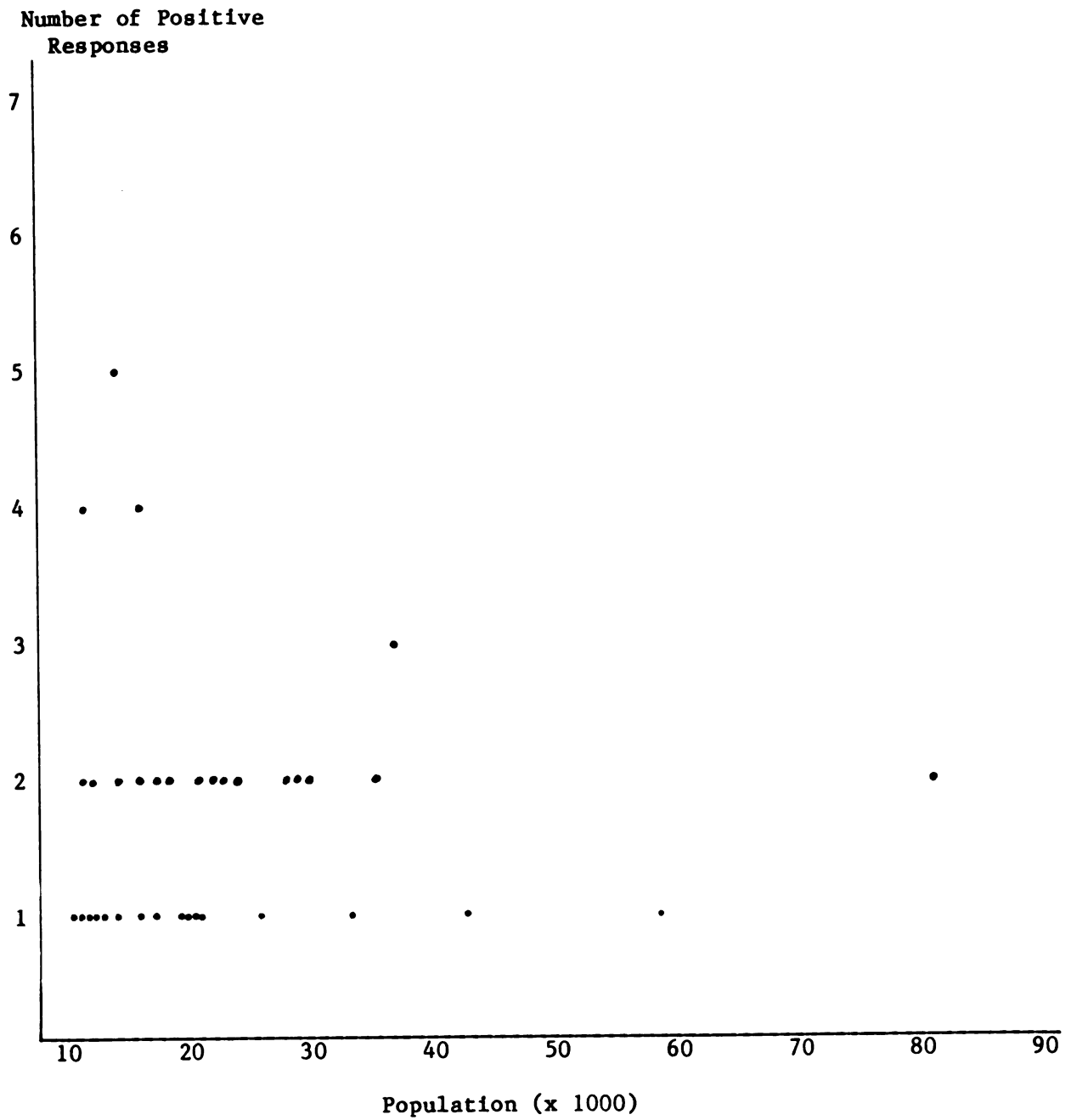
D. Implementation by Medium-Sized cities (Population 10,000 - 89,999)

The total number of positive responses to questions 8 through 14 per local unit of government for medium size cities is displayed in the scatter diagram according to the population of the responding city (Figure 5-3). Of the 38 responding cities, three cities had enough positive responses to be classified as effectively implementing the legislative op-

Figure 5-3

Number of Positive Responses
by City Population (10,000 to 89,999)

(Questions 8 to 14)



portunities. One city responded positively to three questions and 15 cities responded positively to two questions. Thus, 16 cities are marginally effective at implementing the legislative opportunities. The remaining 19 cities had one positive response and are determined to be ineffective at implementing the legislative opportunities. Of the 38 cities, 50 percent were ineffective and 84.2 were classified as ineffective or marginally effective.

The percent of positive city responses to survey questions 8 through 14 is summarized in Table 5-5. A positive response was received less than 25 percent of the time for questions 8, 10, 12, 13, and 14. This is interpreted as ineffective implementation of the respective legislative opportunities. One question (question 11) yielded a positive response of 39.5 percent. This is interpreted as marginal effectiveness in implementing an element for solar access in comprehensive land-use plans. One question (question 9) yield a positive response greater than fifty percent. In 97.4 percent of the medium-sized cities, it was indicated that the existing city zoning ordinances did not prohibit the construction of earth-sheltered structures.

The chi-square test was used to determine if a relationship existed between the results of the questions pertaining to the medium size city zoning ordinances (questions 8, 9, and 10) and zoning updates since 1978. The purpose of this was to see if the medium size city governments had taken advantage of the respective legislative opportunities when updating zoning ordinances. The results of this test (Table 5-6) were similar to the respective county and small city results. The results of questions 8, 9, and 10 were found to be unrelated to the results of question 7. A zoning ordinance update was not related to implementation of

Table 5-5

Percent of Positive Medium Size City Responses to Survey Questions		
Question	Percent of Positive Responses	Effectiveness of Implementation
8. Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems?	5.0	Ineffective
9. Does the existing zoning ordinance prohibit the construction of earth-sheltered structures. (A "no" response is considered positive.)	97.4	Effective
10. Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing?	13.2	Ineffective
11. Does the city's (county's) comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems?	39.5	Marginally effective
12. Has the city (county) applied for a Community Energy Planning Grant from the Minnesota Energy Agency?	2.6	Ineffective
13. Has the city (county) received a Community Energy Planning Grant from the Minnesota Energy Agency?	0	Ineffective
14. Does the city's (county's) subdivision regulations include standards and requirements for solar access?	5.3	Ineffective

Table 5-6

SUMMARY OF CHI-SQUARE TEST FOR MEDIUM SIZE CITY DATA						
Zoning Update Since 1978	Response to Question					
	8		9*		10	
	Yes	No	Yes	No	Yes	No
Yes	3	18	19	1	4	16
No	3	14	16	0	1	15
Chi-Square	1.931		.144		.069	
Critical Value of Chi-Square	3.841		3.841		3.841	
Reject Hypothesis of Variable Independence	No		No		No	

*Note: A "no" response to question number 9 is interpreted as a positive response.

solar access legislation, not prohibiting the construction of earth-sheltered construction, and distinguishing between earth-sheltered housing and basement housing. This suggests that the zoning ordinance updates since 1978 were not effective at implementing the related legislative opportunities.

The conclusion derived from these results is to not reject the hypothesis with respect to medium size city implementation of the respective state legislation opportunities. Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the medium size city level on a statewide basis.

E. Implementation by Large Size Cities (Population greater than 90,000)

The total number of positive responses to questions 8 through 14 per local unit of government for large size cities is displayed in the scatter diagram according to population of the responding cities (Figure 5-4). Both of the responding cities had enough positive responses to be classified as effectively implementing the legislative opportunities. One city had five positive responses, the other had four positive responses.

The percent of positive responses to survey questions 8 through 14 is summarized in Table 5-7. A 100 percent positive response was received for questions 8, 9, and 14. This is interpreted as effective implementation of the legislative opportunities. Both cities provide for solar access in their zoning ordinances and subdivision regulations. Both cities also do not prohibit the construction of earth-sheltered structures. The remaining questions received 50 percent positive responses, which is interpreted as marginal effectiveness of implementation.

Figure 5-4

Number of Positive Responses
by City Population (90,000+)

(Questions 8 to 14)

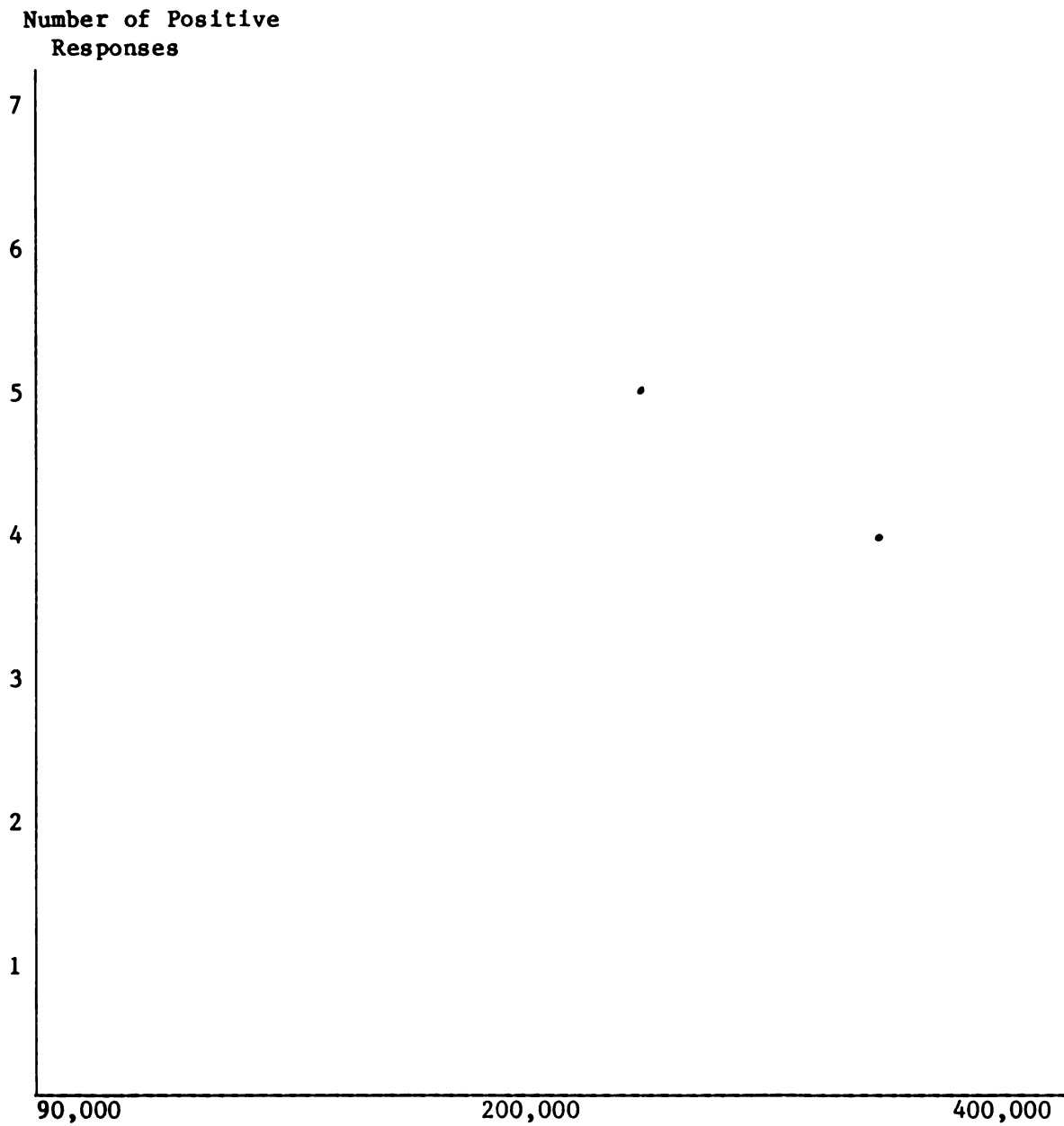


Table 5-7

Percent of Positive Large City Responses to Survey Questions		
Question	Percent of Positive Responses	Effectiveness of Implementation
8. Does the existing zoning ordinance provide for the protection and encouragement of access to direct sunlight for solar energy systems?	100	Effective
9. Does the existing zoning ordinance prohibit the construction of earth-sheltered structures. (A "no" response is considered positive.)	100	Effective
10. Does the existing zoning ordinance distinguish between earth-sheltered housing and basement housing?	50	Marginally effective
11. Does the city's (county's) comprehensive land-use plan contain an element for the protection and development of access to direct sunlight for solar energy systems?	50	Marginally effective
12. Has the city (county) applied for a Community Energy Planning Grant from the Minnesota Energy Agency?	50	Marginally effective
13. Has the city (county) received a Community Energy Planning Grant from the Minnesota Energy Agency?	50	Marginally effective
14. Does the city's (county's) subdivision regulations include standards and requirements for solar access?	100	Effective

A chi-square test was not conducted for this sample because the number of respondents was small (only two) and the results would be of no value to this study.

The conclusion derived from these results is to reject the hypothesis with respect to large size city implementation of the respective state legislative opportunities. There is not substantial evidence to indicate that Minnesota legislation related to energy-efficient land-use planning has not been effectively implemented at the large size city level on a statewide basis.

F. Implementation by Cities within the Twin Cities Metropolitan Region

The Twin Cities Metropolitan Government has been directed by state legislative amendment to make plans for the protection and development of access to direct sunlight for solar energy systems (see Chapter 2, Section E.) In conjunction with this, communities within the metropolitan region include a solar access element in their comprehensive plans. A comparative analysis of respondent communities within and outside of the metropolitan region was used to determine effectiveness of implementation within the region. The relevant survey question is question 11. The null hypothesis for this evaluation is: there is no difference between the proportion of positive responses from sample communities within the metropolitan region and sample communities outside the metropolitan region.

Table 5-8 provides a summary of responses to question 11 from metropolitan communities and nonmetropolitan communities. Of the metropolitan communities, 51.1 percent responded positively, compared to 5.6 percent for nonmetropolitan communities. It was determined by inspection

Table 5-8

Comparative Results to Question 11: Metropolitan to Nonmetropolitan Cities						
Question 11: Does the city's (county's) comprehensive land use plan contain an element for the protection and development of access to direct sunlight for solar energy systems?						
Responses	Metropolitan Cities		Nonmetropolitan Cities		All Cities	
	Total	Percent	Total	Percent	Total	Percent
Yes	23	51.1	3	5.6	26	26
No	22	49.9	49	40.7	71	71
No Plan	0	0	3	5.6	3	3
Totals	46	100	54	100	100	100

that there is a difference and that implementation is more effective within the metropolitan region than outside the metropolitan region. Also, according to criteria established in Section 14 of this chapter, it was determined that 51.1 percent be interpreted as effective implementation of the legislative opportunity. Based on this information, reject the null hypothesis of no difference.

The conclusion derived from these results is to reject the central hypothesis with respect to metropolitan implementation of the respective state legislative opportunity. Minnesota legislation related to energy-efficient land-use planning has been effectively implemented in Twin Cities Metropolitan Region.

CHAPTER VI

CONCLUSION

A. Summary of Minnesota's Energy-Related Land-Use Legislation

State energy-related land-use legislation pertinent to this research can be divided into two categories: enabling legislation and mandatory legislation. The portions of the municipal and county planning acts which address solar access belong to the former category. The allowance for earth-sheltered construction in the municipal act is also in a permissive form. The county planning act, unlike the municipal planning act, takes the form of mandatory legislation with regard to earth-sheltered construction by not allowing the prohibition of such construction. The Metropolitan Government Act mandates that communities within the metropolitan region include a solar access element in their comprehensive plans. Finally, the state legislative act which allowed communities to apply for community energy planning and implementation grants is, for purposes of this research, considered enabling legislation.

B. Summary of Results

This research was an attempt to discover the relationship between pertinent state legislation and the acceptance through implementation of the legislation at the local government levels. To do so, the research focused on five categories of local government, including 1) counties, 2) small size cities, 3) medium size cities, 4) large size cities, and 5) cities within the Twin Cities Metropolitan Region. It was discovered that the degree of implementation of the various legislative opportunities was not substantial enough to reject the central hypothesis for

county governments, small size cities, and medium size cities. The conclusion for the respective categories is that the relevant state legislation has not been effectively implemented on a statewide basis. For large size cities and metropolitan cities, evidence from this research called for the rejection of the central hypothesis. In fact, the evidence indicated that the cities within these categories were implementing the related legislative opportunities.

C. Results in Perspective

The most salient observations emerging from this research suggest that state enabling legislation does not effectively assure enactment of energy-related land-use planning strategies in local ordinances and regulations. This is especially true of counties and cities with populations less than 90,000. State mandatory legislation appears to be more effective at eliciting an appropriate response. A case in point is the mandatory language of the metropolitan planning act requiring a solar access element in cities' comprehensive plans. Of the cities within the metropolitan region, 51.1 percent contain such an element, compared to 5.6 percent of the cities outside the metropolitan region. The 51.1 percent is actually misleadingly low since many cities within the region indicated that their plans were in the process of being rewritten to contain an element for solar access. For purposes of recording results, these cities were considered as not having the appropriate element in their plans at the time the survey was conducted.

This research was not designed to determine why (or why not) the state legislation was implemented locally. However, primary conclusions lead one to ask why the legislation has been effectively implemented in

some cities and not others. The scatter diagrams in the previous chapter suggest a possible link, although not strong, between a city's population size and implementation. Other possibilities for such relationships may exist between a city's average education or income levels, growth rate, or public expenditures levels. An important next step in associated research is to find an answer to the question, "why?".

Conversation with planners and zoning administrators during the course of the survey revealed some insights. One reason suggested for the lack of implementation of solar access elements in county zoning ordinances was that the counties were primarily rural and lot sizes were restricted to one-half or one acre or larger. Thus, it was felt by respondents that there was no need for a solar access element.

Another reason for lack of enactment emerged from cities which were fully developed. Respondents from some of these communities felt there was no need for such ordinance amendments since their land was fully developed. Any future need for any related problems which might arise could be handled through the use of variances.

A third reason given for lack of local enactment was lack of funds for plan and zoning ordinance updates. It was felt that decreasing funds in local budgets did not allow for these changes because of low priority status.

The indicated lack of planning funds provides a convenient opportunity to discuss the status of state-sponsored energy planning and plan implementation grants. A very small percentage of cities and counties surveyed indicated application for or reception of said grants. One of the reasons for such a low response rate was a lack of knowledge of the grants' existence. Perhaps more importantly, though, is the fact that a

state budget deficit required the discontinuation of the energy planning grants program in late 1981. Consequently, only those local governments fortunate to have applied for grants early in the program's existence received them.

D. Need for Further Research

The results of this research indicate that the implementation of state energy-related land-use planning goals could be enhanced by the use of mandatory language in the various legislative acts. This may not be feasible or prudent for a variety of reasons. One such reason is an acknowledged resistance to local government interference by the state government. Also, as indicated in Section I of Chapter II, there may exist other legal or psychological barriers which should be reviewed prior to legislative mandate.

Additional research should be conducted to determine the existing barriers to energy-related land-use legislation. One direction for research is to determine time and cost criteria for revising local ordinances to comply with state guidelines. This would serve as a launching point for streamlining the process and placing the cost of such revisions within the financial reach of most local governments.

A P P E N D I C E S

APPENDIX A

County Planning Act Chapter 394

Summary Of Act

- 394.21 Authority to carry on county planning and zoning activities
- 394.22 Definitions
- 394.23 Comprehensive plan
- 394.24 Official controls
- 394.25 Forms of controls
- 394.26 Public hearings
- 394.27 Creation and duties of a board of adjustment
- 394.28 Appropriation for planning activity
- 394.29 May employ director and staff
- 394.30 Planning commissions
- 394.301 Conditional use permits
- 394.302 Relation to other county authority
- 394.32 Cooperation with municipalities
- 394.33 Relations with towns
- 394.34 Interim zoning
- 394.35 Filing with the county recorder
- 394.36 Nonconformities
- 394.361 Official map
- 394.362 Variances; adverse effect on environment
- 394.37 Enforcement

There are two amendments concerning solar access in this Act.

The first is in subdivision 2 of 394.25, forms of control.

Subd. 2. Zoning ordinances establishing districts within which the use of land or the use of water or the surface of water pursuant to section 378.32 for agriculture, forestry, recreation, residence, industry, trade, soil conservation, water supply conservation, surface water drainage and removal, conservation of shorelands, as defined in section 105.485, and additional uses of land and of the surface of water pursuant to section 378.32, may be by official controls encouraged, regulated, or prohibited and for such purpose the board may divide the county into districts of such number, shape, and area as may be deemed best suited to carry out the comprehensive plan. Official controls may also be applied to wetlands preservation, open space, parks, sewage disposal, protection of ground water, protection of flood plains as defined in section 104.02, protection of wild, scenic or recreational rivers as defined in section 104.33, protection of slope, soils, unconsolidated materials or bedrock from potentially damaging development, preservation of forests, woodlands and essential wildlife habitat, reclamation of non-metallic mining lands; protection and encouragement of access to

direct sunlight for solar energy systems as defined in section 116H.02, subdivision 11; and the preservation of agricultural lands.

The second amendment concerning solar access is in subdivision 7 of 394.27, creation and duties of a board of adjustment.

Subd. 7. The board of adjustment shall have the exclusive power to order the issuance of variances from the terms of any official control including restrictions placed on nonconformities. Variances shall only be permitted when they are in harmony with the general purposes and intent of the official control in cases when there are practical difficulties or particular hardship in the way of carrying out the strict letter of any official control, and when the terms of the variance are consistent with the comprehensive plan. "Hardship" as used in connection with the granting of a variance means the property in question cannot be put to a reasonable use if used under the conditions allowed by the official controls; the plight of the landowner is due to circumstances unique to his property not created by the landowner; and the variance, if granted, will not alter the essential character of the locality. Economic considerations alone shall not constitute a hardship if a reasonable use for the property exists under the terms of the ordinance. No variance may be granted that would allow any use that is prohibited in zoning district in which the subject property is located. The board of adjustment may impose conditions in the granting of variances to insure compliance and to protect adjacent properties and the public interest. The board of adjustment may consider the inability to use solar energy systems a "hardship" in the granting of variances.

APPENDIX B

Municipal Planning Act Chapter 462

Summary of Act

- 462.351 Municipal planning and development; statement of policy
- 462.352 Definitions
- 462.353 Authority to plan
- 462.354 Organization for planning
- 462.355 Preparation, adoption, and amendment of comprehensive municipal plan
- 462.356 Procedure for plan effectuation; generally
- 462.357 Procedure for plan effectuation; zoning
- 462.358 Procedure for plan effectuation; subdivision regulations
- 462.359 Procedure for plan effectuation; official maps
- 462.36 Certified copies filed with county recorder
- 462.361 Judicial review
- 462.362 Enforcement and penalty
- 462.363 Present ordinances continued
- 462.364 Inconsistent laws

There are four amendments concerning solar access in the Act. The first is in subdivision 1 of 462.357, procedures for plan effectuation; zoning.

Subd. 1. Authority for zoning. For the purpose of promoting the public health, safety, morals and general welfare, a municipality may by ordinance regulate the location, height, bulk, number of stories, size of yards and other open spaces, the density and distribution of population, the uses of buildings and structures for trade, industry residence, recreation, public activities, or other purposes, and the uses of land for trade, industry, residence, recreation, agriculture, forestry, soil conservation, water supply conservation, conservation of shorelands, as defined in section 105.485, access to direct sunlight for solar energy systems as defined in section 116H.02, flood control or other purposes, and may establish standards and procedures regulating such uses. The regulations may divide the municipality into districts or zones of suitable numbers, shape and area. the regulations shall be uniform for each class or kind of buildings, structures or land and for each class or kind of use throughout such district, but the regulations in one district may differ from those in other districts. The ordinance embodying these regulations shall be known as the zoning ordinance and shall consist of text and maps. A city may by ordinance extend the application of its zoning regulations to unincorporated territory located within two miles of its limits in any direction, but not in a county or town which has adopted zoning regulations; provided that where two or more noncontiguous municipalities have boundaries less than four miles apart, each is authorized to control the zoning of land on its side of a line equidistant between the two noncontiguous

municipalities unless a town or county in the affected area has adopted zoning regulations. Any city may thereafter enforce such regulations in the area to the same extent as if such property were situated within its corporate limits, until the county or town board adopts a comprehensive zoning regulation which includes the area.

The second amendment is in subdivision 6 of 462.357

Subd. 6. Variances. Subdivision regulations may provide for a procedure for varying the regulations as they apply to specific properties where an unusual hardship on the land exists, but variances may be granted only upon the specific grounds set forth in the regulations. Unusual hardship includes, but is not limited to, inadequate access to direct sunlight for solar energy systems.

The third amendment made in 1978 was further amended in 1980 when the subdivision legislation was overhauled. The amendment is in subdivision 2a of 462.358, procedure for plan effectuation; subdivision regulations.

Subd. 2a. Terms of regulations. The standards and requirements in the regulations may address without limitation: The size, location, grading, and improvement of lots, structures, public areas, streets, roads, trails, walkways, curbs and gutters, water supply, storm drainage, lighting; sewers, electricity, gas, and other utilities; the planning and design of sites; access to solar energy; and the protection and conservation of flood plains, shorelands, soils, water, vegetation, energy air quality, and geologic and ecologic features. The regulations shall require that subdivisions be consistent with the municipality's official map if one exists and its zoning ordinance, and may require consistency with other official controls and the comprehensive plan. The regulations may prohibit certain classes or kinds of subdivisions in areas where prohibition is consistent with the comprehensive plan and the purposes of this section, particularly the preservation of agricultural lands. The regulations may prohibit the issuance of building permits for any tracts, lots, or parcels for which required subdivision approval has not been obtained. The regulations may permit the municipality to condition its approval on the construction and installation of sewers, streets, electric, gas, drainage, and on the receipt by the municipality of a cash deposit, certified check, irrevocable letter of credit, or bond in an amount and with surety and conditions sufficient to assure the municipality that the utilities and improvements will be constructed or installed according to the specifications of the municipality. The regulations may permit the municipality to condition its approval on compliance with other requirements reasonably related to the provisions of the regulations and to execute development contracts embodying the terms and conditions of approval. The municipality may enforce such agreements and conditions by appropriate legal and equitable remedies.

The fourth amendment is a 1978 change and it is in subdivision 6 of 462.358.

Subd. 6. Appeals and adjustments. Appeals to the board of appeals and adjustments may be taken by any affected person upon compliance with any reasonable conditions imposed by the zoning ordinance. The board of appeals and adjustments has the following powers with respect to the zoning ordinance:

(1) To hear and decide appeals where it is alleged that there is an error in any order, requirement, decision, or determination made by an administrative officer in the enforcement of the zoning ordinance.

(2) To hear requests for variances from the literal provisions of the ordinance in instances where their strict enforcement would cause undue hardship because of circumstances unique to the individual property under consideration, and to grant such variances only when it is demonstrated that such actions will be in keeping with the spirit and intent of the ordinance. Undue hardship includes, but is not limited to, inadequate access to direct sunlight for solar energy systems. The board of appeals and adjustments or the governing body as the case may be, may not permit as a variance any use that is not permitted under the ordinance for property in the zone where the affected person's land is located. The board or governing body as the case may be, may permit as a variance the temporary use of a one family dwelling as a two family dwelling. The board or governing body as the case may be may impose conditions in the granting of variances to insure compliance and to protect adjacent properties.

APPENDIX C

Regional Development Act of 1969

Summary of Act

- 462.381 Title
- 462.382 Application
- 462.383 Purpose
- 462.384 Definitions
- 462.385 Designation of regions
- 462.386 Multi-county planning and development; conformance with regions
- 462.387 Regional development commissions; establishment
- 462.388 Commission membership
- 462.389 Development commission chairman; officers and staff
- 462.39 Powers and duties
- 462.391 Specific powers and duties
- 462.392 Special studies and reports
- 462.393 Reports
- 462.394 Citizen participation and advisory committees
- 462.395 Duties of state agencies, state planning agency
- 462.396 Financial; state assistance
- 462.397 Borrowing money; certificates of indebtedness

This act applies to the Regional Development Commissions. The state is split into 13 RDC's.

There is one solar access amendment in this act and it is found in subdivision 3 or 462.39.

Subd. 3. Planning. The commission shall prepare and adopt, after appropriate study and such public hearings as may be necessary, a comprehensive development plan for the region. The plan shall consist of a compilation of policy statements, goals, standards, programs, and maps prescribing guides for an orderly and economic development, public and private, or the region. The comprehensive development plan shall recognize and encompass physical, social, or economic needs of the entire region including but not limited to such matters as land use, parks and open space land needs, access to direct sunlight for solar energy systems, the necessity for and location of airports, highways, transit facilities, public hospitals, libraries, schools, public and private, housing, and other public buildings. In preparing the development plan the commission shall use to the maximum extent feasible the resources studies and data available from other planning agencies within the region, including counties, municipalities, special districts, and subregional planning agencies, and it shall utilize the resources of the state planning agency to the same purpose. No development plan or portion thereof for the region shall be adopted by the commission until it has been submitted to the state planning

agency for review and comment and a period of 60 days has elapsed after such submission. When a development plan has been adopted, the commission shall distribute it to all local government units within the region.

APPENDIX D

Metropolitan Government Chapter 473

There are two solar access amendments in this chapter. The first is in an introductory section on plans, 473.05.

473.05 Plans. Subdivision 1. The commission shall make plans for the physical, social, and economic development of its metropolitan area with the general purpose of guiding and accomplishing a coordinated and harmonious development of the area and of public facilities, improvements, and utilities which do not begin and terminate within the boundaries of any single governmental unit or which do not relate exclusively to the development of any single governmental unit. Such plans may include, among other things, suggestions as to highways and other transportation facilities, parks and recreational facilities, methods for protection and assuring access to direct sunlight for solar energy systems, drainage and water supply facilities, public buildings, utilities and services, as well as suggested standards for the subdivision of land and for control over the construction, height, bulk, location and use of buildings and premises. The commission may adopt by resolution of a majority of its full membership any such plan or portion of any plan as its official recommendation for the development of the area.

The second amendment is in the Metropolitan Land Use Planning Act which is summarized below.

- 473.851 Legislative findings and purpose
- 473.852 Definitions
- 473.853 Advisory committee
- 473.854 Guidelines
- 473.855 Metropolitan system statement
- 473.856 Metropolitan system statement; amendments
- 473.857 System statements; reconciliation procedures
- 473.858 Comprehensive plans; local governmental units
- 473.859 Comprehensive plan content
- 473.86 Cities
- 473.861 Towns
- 473.862 Counties
- 473.863 School districts; capital improvement programs
- 473.864 Plans and programs; adoption; amendment
- 473.865 Implementation of plans
- 473.866 Contested cases; administrative and judicial review
- 473.867 Planning assistance; grants; loans
- 473.868 Housing
- 473.869 Extension
- 473.87 Exemption from levy limit
- 473.871 New municipal sewer systems
- 473.872 Application

The amendment is in subdivision 2 of 473.859, comprehensive plan content. Note that this is mandatory language and requires communities in the metropolitan area of St. Paul and Minneapolis to include a solar access element in their comprehensive plan.

Subd. 2. Land use plan. A land use plan shall designate the existing and proposed location, intensity and extent of use of land and water for agricultural, residential, commercial, industrial and other public and private purposes, or any combination of such purposes. A land use plan shall contain a protection element, as appropriate, for historic sites and the matters listed in section 473.204, and an element for protection and development of access to direct sunlight for solar energy systems. A land use plan shall also include a housing element containing standards, plans and programs for providing adequate housing opportunities to meet existing and projected local and regional housing needs, including but not limited to the use of official controls and land use planning to promote the availability of land for the development of low and moderate income housing.

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