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COMMUNITY ENERGY PLANNING IN MARYSVILLE, KANSAS

by

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Chapter I

INTRODUCTION

Since 1973/74, the U.S. has had several major "energy crises" that signal "a fundamental change in the ability of industrialized nations to chart their own economic destinies and to guarantee the economic security of their citizens."[1] Energy price and supply shocks have fueled inflation, led to large balance of payments deficits and exposed inherent vulnerabilities of the U.S. energy system. The preoccupation of national energy planning efforts to deal with these problems have been policies developed and administered at the national level to increase energy supplies and to promote conservation with higher prices.[2]

> The overriding resource problem as we approach the 21st century is energy - supply, demand and cost. ... The increasing cost of energy will affect all phases of life and, regardless of what new sources are developed, will dictate more efficient and more conservative use of power.[3]

The complex issue of solving energy problems is not only a technical question of how to provide energy services, but also a question of preserving democratic values as we plan and develop solutions. While there is certainly a broad range of possible energy futures, the range involved can be illustrated by two contradictory visions based on different interpretations of the energy problem and the choice of solutions as shown in the following two examples.

1. <u>The Hard Path Energy Future Scenerio</u> implies: continued reliance on and expansion of conventional energy sources: coal (mainly strip mined then made into electricity and synthetic liquid fuels), and oil and gas (increasingly from arctic and

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[1] U.S. Department of Energy, <u>National Energy Plan II</u> May 1979, p. 1.

[2] Examples are; phased decontrol of oil prices, deregulation of natural gas prices, synthetic fuel programs, subsidized funding of nuclear power and programs to increase the use of coal.

[3] Frank C. Whitmore, Jr., <u>Resouces for the 21st Century: Summary and Conclusions of the</u> International Centennial Symposium of the U.S. Geological Survey (Geological Survey Circular 857: Washington, 1981), p. 38.

offshore wells), and nuclear fission (eventually the fast breeder reactor); energy systems are increasingly large scale and capital intensive with centralized corporate/government management and control; divergence between the amount of primary energy needed to provide end use energy service and National security and local energy supply vulnerabilities continue. The 'Hard Path' assumes that increases in economic growth (GNP) require increasing energy consumption.[4]

2. The Soft Path Energy Future Scenerio first articulated by Amory Lovins, combines the utilization of the following two basic approaches to reduce conventional energy demand yet provide needed energy services. ways:[5]

   a) Improve the efficiency of energy use through 'technical fixes' by designing and building appliances, automobliles, buildings, etc. that provide equal or better service or work with less energy input.

   b) The rapid deployment of soft or appropriate technologies. Three of the basic soft or appropriate technologies are 1) solar heating and cooling, 2) conversion of organic wastes into gaseous or liquid fuels and 3) wind energy conversion systems. These technologies are defined by five characteristics:

      i) They rely on renewable energy flows,

      ii) They are diverse, each designed for maximum effectiveness in a particular circumstance,

      iii) They are flexible and relatively low technology - which does not mean unsophisticated, but rather easy to understand and use,

      iv) They are matched in scale and in geographic distribution to end-use needs,

---

[4] Robert Stobaugh and Daniel Yergin eds., Energy Future (New York: Ballantine, 1979), pp. 173-176.

[5] The two energy future visions were first published in a now classic article, "Energy Strategy: The Road Not Taken," in Foreign Affairs October 1976, by Amory Lovins. Lovins expanded and strengthened the 'Soft Path' argument in Soft Energy Paths - Toward A Durable Peace (San Francisco: Friends of the Earth, 1979) and most recently in Brittle Power - Energy Strategy For National Security (Andover, Mass.: Brick House, 1982).

v) They are matched in energy quality (form and temperature) to end use needs. The energy consumption/economic growth (GNP) link is assumed to be flexible, allowing sustained economic growth with zero or negative energy consumption growth.

c) Transitional technologies that use fossil fuels sparingly are needed to build a bridge to an energy income economy, conserving those fuels, especially oil and gas, for petor chemicals and leaving as much as possible in the ground for emergency use. Includes cogeneration for electricity and more sophisticated methods of burning coal cleanly and efficiently.

The 'Soft Path' energy future strategy is based on the belief that the fossil fuel age has peaked and that instead of continuing to use nonrenewable resouces, fossil fuels (oil and gas), until exhaustion we must begin to plan and develop a new sustainable energy base. The transitions in energy that historically have been made are critical to understanding our current problem. A chart of fuel use in the U.S. throughout its history appears as three overlapping waves as shown in Figure 1.
It has gone through two major transitions as it moved from solar energy (wood) to coal and then from coal to petroleum, natural gas and centrally generated electricity. In each transition we moved to a "cheaper" and more versatile fuel, and with each transition we significantly increased consumption, productivity and affluence. We readily and effectively, though not without turmoil, substituted cheap versatile energy for capital and labor.[6] According to the 'Soft Path' view, the crux of our problem is that we are now obliged to make another transition, not to a Hard Path nuclear electric future but to a cheaper and more diverse Soft Path energy future.

While most national planning efforts have focused on the 'Hard Path', a parallel 'Soft Path' approach of decentralized local energy policy planning has been building at the grassroots level. "However far removed from the origins of our energy problems their impacts nevertheless have been felt by people in the local communities where they live and work".[7] Until there is a transition

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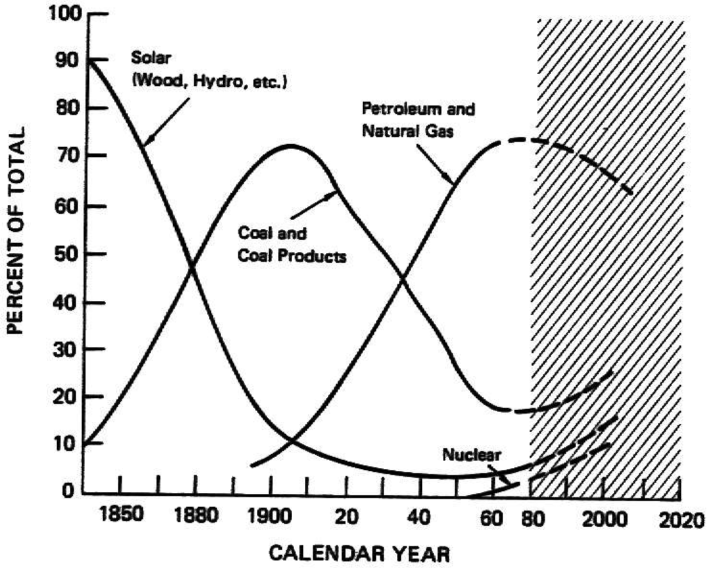
[6] The social and political struggles involved in these energy transitions are detailed in Energy Politics by David Howard Davis (New York; St. Martin's Press, 1982).

[7] Ronald D. Brunner and Robon Sandenburgh, eds., Community Energy Options - Getting Started in Ann Arbor (Ann Arbor: The University of Michigan Press, 1982), Introduction. Two other books that present expamples and analysis of this activity are Resettling America by Gary J. Coates (Andover, Mass.: Brick House, 1981) and Self-Reliant Cities by David Morris (San Francisco: Sierra Club Books, 1982).



Source: "Historical Statistics of the United States," U.S. Bureau of Mines, U.S. Department of The Interior, Washington D.C., 1974.

Figure 1: Historical Use of Energy in U.S.

to some sustainable energy system, the impacts of expensive energy and interruptions in energy supply on the community, local government, and business will continue to be severe.

Confronted with serious energy problems,

> "Communities began to develop solutions to their own energy problems with impressive results. They quietly reduced unnecessary and inefficient uses of energy, developed local and renewable energy sources, and realized substantial dollar savings. Spurred by word of mouth of these success stories, persistent energy price increases, and threatened disruption of energy supplies, leaders in an increasing number of communities have become interested in the potential payoffs of a local energy policy. Initially their need is to understand what can be done, and whether and how to proceed. Typically, their response is to begin the search for energy policy and program op-

> tions by contacting other communities that started earlier and already have some experience."[8]

Community energy planning can be defined as the process of envisioning a desired future state of energy supply and consumption for a local area and designing appropriate measures to achieve it. The energy plan can be thought of as an another element of the community comprehensive plan which, along with transportation, housing, social services and other elements, emphasizes different community systems that contribute to the general public welfare.[9] Traditionally comprehensive planning has used land resouces as the cohesive element. Perhaps as we enter a new age of ecological scarcity this kind of planning will require equal consideration of energy and other resources such as water.

The similarities of energy planning with other traditional kinds of planning are:

1. Basic purpose and legal justification,

2. Basic planning process,

3. Strong concern with how land is used,

4. Reliance on the same regulatory and fiscal devices for implementing the plan.

While community energy planning can be considered to be an emerging planning innovation, there are examples of community energy planning within state and local governments and regional organizations that provide a considerable number and variety of studies, reports and plans. While most of the activity has been in major urban areas, often overlooked in developing a planning innovation are small towns and rural areas. Most often small towns and rural areas experience energy planning of a confrontational nature over the siting of energy facilities or other environmental conflicts related to 'Hard Path' energy development.

Community energy planning experience is needed in small towns and rural areas for several reasons:

1. There are very few examples, particularly for small town and rural areas,

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[8] Ibid., p. 1.

[9] Martin Schweitzer, "The Link Between Traditional Planning and Energy Management", presented at the <u>Community Energy Planning Conference</u> sponsored by the Tennessee Chapter of the APA (Gatlinburg, TN: n.p. June 1981), p. 2.

2. The kinds of information needs, procedures for gathering information and the kinds of analyses needed are not well established,

3. Across the country there has been a general movement out of the central cities to the suburbs and beyond, a reversal of decades of increasing metropolitan concentration; for the first time in decades nonmetropolitan and rural Kansas is growing[10]

4. lack of technical, administrative and fiscal capacity of local government to develop planning innovations let alone do 'planning'.

A review of recent publications indicates that while most of the studies are from single communities and metropolitan areas, the county is often the study and planning area. One of the most popular and easily understood energy planning methodologies is based on collecting information at the county level.[11] Planning at the county level allows for a more ecological approach since activities such as agriculture and mining can be included. Also since counties are interlinked, a program of county energy planning would include the entire country geographically.

This report describes part of the community energy planning process for a small rural town - Marysville, Kansas. An example of the comprehensive community energy planning process is shown in Figure 2.

The report will focus on the following parts of the community energy planning process:

1. Inventory important physical components of the community energy system,

2. Develop a profile of how energy is being utilized,

3. Compare different future energy demand and supply scenerios,

4. Identify alternatives and potential response strategies,

5. Recommend implementation strategies.

The account of physical components and the energy utilization profile for Marysville are documented and described based on information that was collected during the Fall 1982 Community Design

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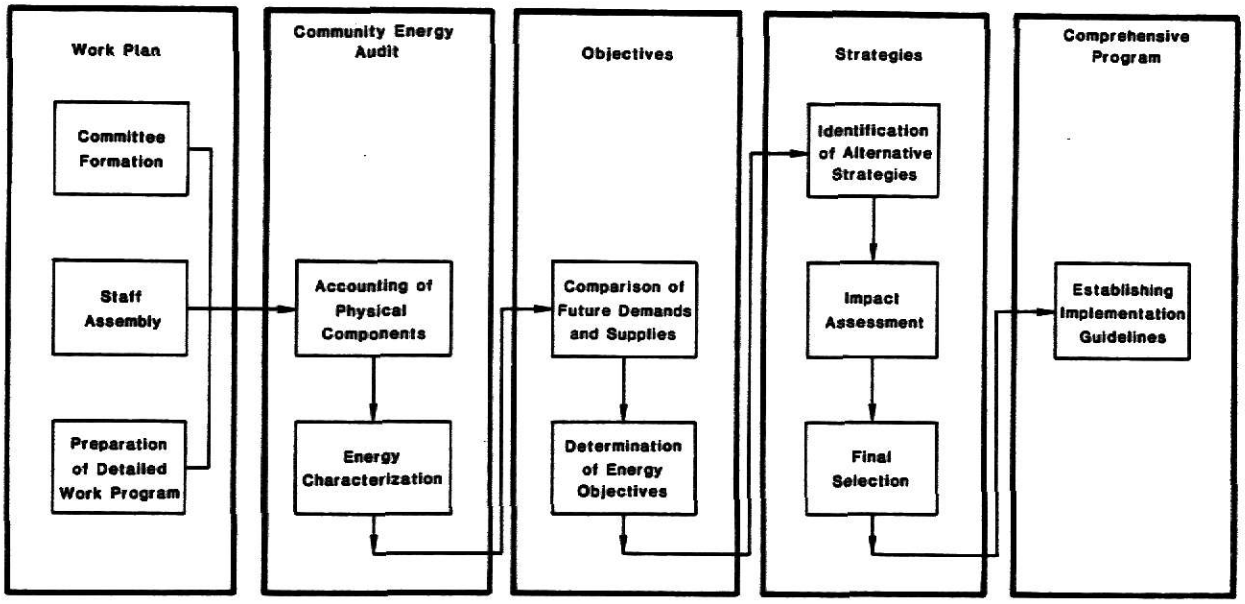
[10] Don Adamchak, "Kansas", American Demographics, <u>American Demographics</u>, October 1983, p. 12.

[11] Jim Benson and Alan Okagaki, <u>County Energy Plan Guidebook</u> (Fairfax, Virginia: Institute For Ecological Policies, 1979).



Source: Michael J. Meshenberg, et al., A Guide For Establishing A Loca
Energy Management Program (Argonne National Laboratory, July 1982), p.

Figure 2: Comprehensive Community Energy Planning Process

Studio (Gary Coates Professor), Department of Architecture and the graduate Department of Regional and Community Planning at Kansas State University in Manhattan Kansas. The class energy project, which was the primary basis for this report, is part of a larger overall study of how Marysville, Kansas can move in the direction of energy/economic sustainability.

Comparison of future energy demands and supplies are based on projecting energy use and cost under the 'Hard Path' and the 'Soft Path energy futures. The 'Hard Path' projection scenerio assumes little change in current energy use levels. Community energy alternatives are identified and utilized in the 'Soft Path' projection scenerio which are based on two strategies:

1. Strategy One - conservation and solar thermal applications reduce energy demand,

2. Strategy Two- non-renewable energy is replaced by renewable energy resources and technologies.

The organization of and the implementation guidelines for a community energy program are briefly addressed:

1. Vision - of the kind of energy future the community wants,

2. Tools, and Techniques - that can move individuals and the community toward the vision,

3. Steps - the slection of steps to take in developing a community energy plan that will move the community toward their vision,

Chapter II

MARYSVILLE 1982 ENERGY DEMAND ASSESSMENT

2.1 INTRODUCTION

Marysville is a small town of about 3,670 people located in the northeastern part of Kansas as shown in Figure 3.

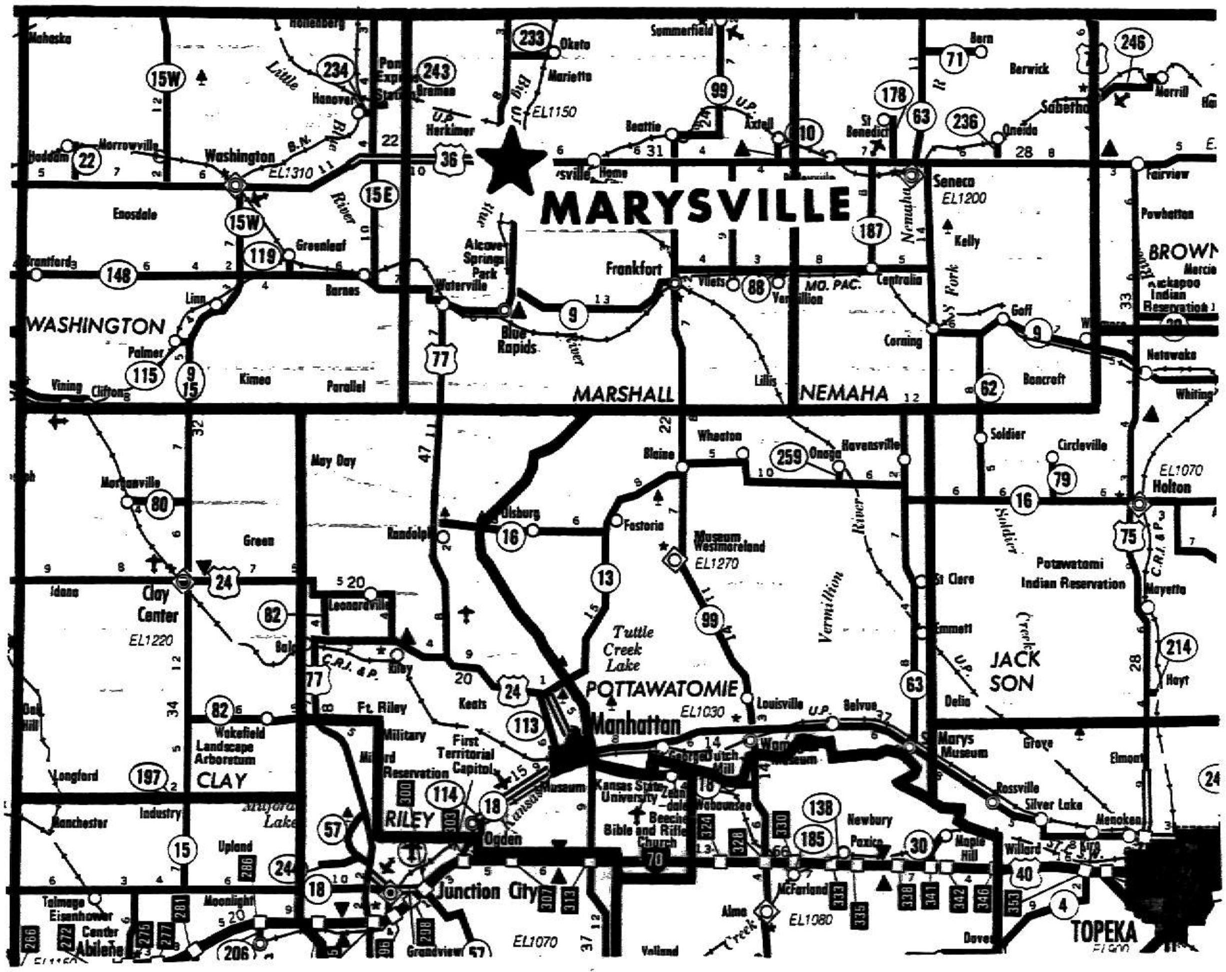


Figure 3: Location Map for Marysville Kansas

Marysville is located at the northern edge of the Flint Hills near the Big Blue River which flows into Tuttle Creek Reservoir. During the frontier days Oregon bound migrants crossed the Big Blue River near Marysville on the historic Oregon Trial.

> "The rolling, grass-covered countryside of the region of Kansas was produced by the action of a pre-historic glacier that pushed south as far as the Kansas River, followed by years of erosion. The northeast section... tall bluestem area, is among the leading Kansas producers of corn and livestock, particularly swine and cattle."[12]

With 92 percent (577) of the cities in Kansas under 5,000 population, how was Marysville choosen for this study project? Several practical reasons why Marysville was chosen include:

1. Proximity to Manhattan (60 miles),
2. Earlier KSU class projects had established the contacts and relationships needed to begin and carry out such a project,
3. There existed a relativley good collection of previous planning related studies.

The other reasons for selecting Marysville are more subjective and difficult to fully identify. But, basically it was percieved that there was a (strong) potential on the part of the people of Marysville to follow-through and implement some of the ideas and projects that would grow out of the energy project and the overall community design project.

2.2 OVERVIEW OF RESEARCH DESIGN

The Marysville energy demand assesment is described in terms of the answers to the following questions:"What kind of energy is being used?", "How much energy is being used for what purpose and in what sector of the community?", and "How much does the energy cost?" Since the term energy actually encompasses the very glue that holds the physical world together we must first describe some limitations for our use of the term. A complete energy flow picture would include the following types of energy.

1. Nonrenewable Energy - energy resources extracted from the ground, ie. petroleum, natural gas, coal, uranium. Often termed conventional energy, or capital energy reserves.

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[12] Socolofsky, Homer E., and Huber Self, Historical Atlas of Kansas (University of Oklahoma Press, 1972), pp. 23 and 57.

2. Renewable Energy - energy derived form the sun, ie. solar thermal, wind, hydo-power, biomass. Renewable resources by definition are never depleted, although some, like forests, require ecologically sound management to remain renewable.

3. Indirect Energy - the "invested" or "embodied" energy in manufactured goods and buildings, ie. the energy used to mine, refine and ship the steel used to make automobiles, or the energy required to prepare building materials and the human and mechanical energy to construct the buildings.

Only nonrenewable energy is included in the Marysville 1982 energy demand assessment. Renewable energy utilization is assumed to account for less than one percent of the current energy demand total and therefore is not included. The energy demand projections in Chapter 3 focus on renewable energy. Accounting for indirect energy would be an extremely complex task and is not included in the scope of this report.

2.2.1 Measuring Energy Use

In addition to the types of energy listed above there are different accounting methods for measuring energy use. The following general definitions are used for this report.

1. End Use Energy - the purpose for which energy is finally used, ie. heating, lighting, travel, industrial processes, etc.

2. Primary Energy - energy derived from natural sources. Energy is required to produce the energy we consume. For example refineries lose roughly 13.5 percent of the original energy input into the refining process. Large electrical generating facilities lose about 70 percent of the energy input and about 7 percent of the original energy value of natural gas is consumed in getting it to places of end use.[13] The average (First Law) efficiency for all energy used in the U.S. was about 31 percent (1976). In other words, almost two-thirds of all the energy used in 1976 was lost to the environment as low quality heat without performing any useful function.[14]

---

[13] Mari Peterson and Diane Tegtmier, Kansas Energy - a resource guide for community action (Shawnee Mission, Kansas: Energy For Rural Self-Reliance and Kansas Natural Resource Council, Spring 1982) Vol. II Community Workbook, p. 51.

[14] G. Tyler Miller, Jr. Energy and Environment, The Four Energy Crises, Second Edition (Belmont, Calif.: Wadsworth Press, 1980), pp. 37-38.

3. Net Useful Energy or Total Energy Use - is the total useful energy of a resource as it is found in nature minus the useful energy used to find, extract and process it, to upgrade energy quality, to meet environmental and safety requirements and to deliver the energy to the user and minus the usefull energy lost as a result of the use of unnesessarily inefficient and wasteful energy systems. Overall U.S. energy efficiency is about 15 percent net useful energy and 85 percent is lost or wasted.[15]

A complete discussion of how and why energy is measured differently would require a review of thermodynamics and physics. The important point is that the current U.S. energy system is based on nonrenewable energy which is being tragically wasted through inefficient energy systems and inappropriate matching of end use energy needs and energy sources.

The following sections describe the methodology and findings by sector of the Marysville 1982 energy demand assessment. Energy demand by energy type is converted into units of one million Btu's labeled as 'MBTU'. One Btu or British thermal unit is defined as the heat energy required to raise the temperature of one pound of water one degree Fahrenheit; a drop (1/20 milliliter) of gasoline has an energy content of approximately 1.5 Btu.

2.3 RESIDENTIAL

2.3.1 Methodology

The residential sector includes the single family detached, multi-family and mobile home dwelling units. Residential energy consumption patterns relate primarily to housing unit and population characteristics. Housing unit characteristics can first be classified by housing type. Of the total number of occupied dwelling units in Marysville, single family detached units account for 84.4 percent, multi-family 12.5 percent and mobile homes 3.4 percent.

Most of the information about residential energy demand was obtained from the 'Marysville Residential Energy Use Survey' which was conducted in the fall of 1982 by teams of Kansas State University students and Marysville residents. The sample residences were selected according to when the they were built. It was felt this would allow the best representation of different house types from all parts of town. The distribution of the sample houses by year built is shown in Table 1. The sample houses were selected from a complete list of housing structures in Marysville by age group that was obtained through the county assessors office.[16]

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[15] Ibid., p. 38.

TABLE 1

Residential Population and Survey Sample Distribution

	Sample		Population	
Year Built	Number	Percent	Number	Percent
1860-1879	0	0 %	19	1.4%
1880-1899	4	7.5	124	9.3
1900-1919	17	32.1	413	30.8
1920-1939	12	22.6	337	25.2
1940-1959	9	17.0	237	17.7
1960-1982	11	20.8	209	15.6
Not reported	(3)	-	-	-
Total	56	100%	1,339	100%

The sample distribution is reasonably close to the population and it is felt this is a fair representation of the Marysville housing stock. The one housing type that did not occur in the sample was multi- family or apartments. Average energy demand figures from the *Riley County Energy Project Report* were used in estimating Marysville multi- family housing energy demand.[17] The 56 survey responses represents 3.7 percent of the 1518 occupied dwelling units reported for Marysville in the 1980 U.S. Census.

The Marysville Residential Energy Use Survey consisted of four parts. The first part was a personal interview with at least one person considered to be a head of the household, and assessed basic characteristics of household energy use, such as the energy type used for space heating. The second part of the survey was a release form that was signed by the respondent which allowed the utility to release to the study team the past 12 months of actual metered energy demand and cost by month. To conduct the first and second parts of the survey the student and Marysville resident volunteers received instruction and training in how the surveys were to be conducted in order to obtain the most complete and accurate information. The third part, which was left with the respondent to be filled out on their own, was an attitude survey that assessed a variety of energy related issues (This part of the survey was the basis for another students report and will not be delt with in this report) . The fourth part consisted of an assessment of various

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[16] Leah Caldwell-Ernst, *Historical Development of Marysville*, (list of residential buildings by location and when they were built; unpublished material gathered summer 1982).

[17] Manhattan Area Energy Alliance, *Riley County Energy Project Report* (Manhattan, Kansas: n.p., October 1982) , p. 5-4.

solar suitability factors such as the available roof and wall area facing south that could be used in some type of conservation/solar retrofit scheme. The complete survey and results are presented in Appendix B.

Complete 12 month (November 1981 to October 1982) energy use data for 51 survey respondents, or 3.7 percent of the occupied dwelling units, was used to estimate Marysville residential total energy demand and cost. Based on the sample data, averages were calculated for natural gas and electrically heated detached single family homes, mobile homes and detached single family homes that are pimarily heated with wood but have significant natural gas heat contributions. Sample electricity and natural gas energy demand averages by dwelling type were applied to the number of dwelling units by type, to obtain an estimate of the total Marysville residential energy demand and cost.

A summary of the sample survey energy demand data is shown in Table 2. The expanded or total energy demand for the Marysville residential sector is shown in Table 3. Wood energy is not shown in Table 2 but affects a reduction in the natural gas energy demand. The totals from Table 3 are used in final tally for the sector.

To disaggregate total residential energy demand by the various end uses a technique is used where the monthly fluctuations in energy demand by energy type allows the major end uses such as space heating, water heating and cooling to be estimated and subtracted out of the total energy useage. Average percentages based on national data, shown below are used to determine the other end uses.[18]

End Use	Percentage of Total Energy Demand
Cooking	6.3%
Refigeration	3.5
Lighting	2.4
Clothes Drying	1.7
Other Appliances	2.6%

The method used for calculating the per unit prices for utility electricity and natural gas is as follows:

1. Electricity: the average number of KWH used in a single family gas heated residence for 12 months was 6946. Divided by 12 months this comes to an average of 578.8 KWH per month. Using the utility cost calculation procedure for October

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[18] The percentages shown are for Riley County Kansas, from the The Riley County Energy Study page 5-5, which were based on averages reported in the County Energy Plan Guidebook page 4-9.

(the latest month of the energy demand data) we get a total cost of $36.76 per month or $0.064 per KWH. Of this total cost the city of Marysville receives from the utility in the form of a franschise tax, $0.02911 per dollar spent or $1.07 or 2.91 percent of the total monthly cost.

2. Natural Gas: the average number of MCF used in a single family gas heated residence for 12 months was 128.1. Dividing by 12 months the average dwelling uses is 10.66 MCF per month. Using the utility cost calculation procedure for October 1982 we get a total cost of $31.25 per month or $2.93 per MCF. Of this total cost the city receives $0.01952 per dollar spent or $0.61 or 1.95 percent of the total monthly cost.

TABLE 2

Residential Survey Sample Of End Use Energy Demand, 1982

		Total Energy Demand			Average Energy Demand		
Dwelling Type/Primary Heating Fuel	No. of Units	Elec. MBTU	N. Gas MBTU	Total MBTU	Elec. MBTU	N. Gas MBTU	Totals MBTU
Single Family							
gas heat	45	1069.8	5860.4	6930.4	23.7	130.2	153.9
electric	2	179.5	-	179.5	89.7	-	89.7
wood	1	35.2	72.1	144.2	35.2	72.1	144.2
Mobile Homes	3	46.4	300.0	346.2	15.5	100.0	115.5
Total	51	1330.9	6232.5	7600.3	26.1	122.2	149.0

TABLE 3

Expanded Residential Energy Demand and Cost, 1982

Dwelling	Number	Total Energy Demand			Average Energy Demand		
Type/Prim. Heat. Fuel	of Units	Elec. MBTU	N. Gas MBTU	Total MBTU	Elec. MBTU	N. Gas MBTU	Total MBTU
Single Fam.							
gas heat	1160	27,492	151,032	178,524	23.7	130.2	153.9
electric	73	6,548	-	6,548	89.7	-	89.7
wood	49	1,161	3,533	4,694	23.7	72.1	95.8
Multi-fam.							
gas heat	172	2,511	18,524	21,035	14.6	107.7	122.3
electric	10	340	-	340	34.0	-	34.0
wood	7	102	413	515	14.6	59.0	73.6
Mobile H.							
gas heat	47	728	4,700	5,428	15.5	100.0	115.5
T. Demand	1,518	38,882	178,202	217,084	25.6	117.4	143.0
T. Cost $	-	729,755	513,736	1,243,491	480	338	819

2.3.2 Overview

The Residential sector accounts for 58.5 percent of the total Marysville energy demand and 50 percent of the total energy cost as shown in Figure 4. The average Marysville residence consumed a total of 143 MBTU of end use energy of which 82 percent is natural gas and 18 percent is electicity. Average total residential energy cost is $875, divided between natural gas at $338 or 42.6 percent of the total cost and electricity $480 or 57.4 percent. The largest energy end use is space heating which accounts for 61.5 percent of total residential end use energy and 31.7 percent of the total residential household energy cost.

From the residential energy use survey it was determined that the "typical" gas heated Marysville single family residence is at a level of about one half of the standard for several thermal related dwelling characteristics, which include: insulation values of R-38 attic and R-11 walls all storm windows and doors, recent caulking and weatherstripping. (See Table &Datacon. and Appendix B). Heat loss calculations estimate that the addition of insulation and improvements in other thermal dwelling characteristics could reduce space heating energy demand by 55 percent, as described in more detail in Chapter 3.

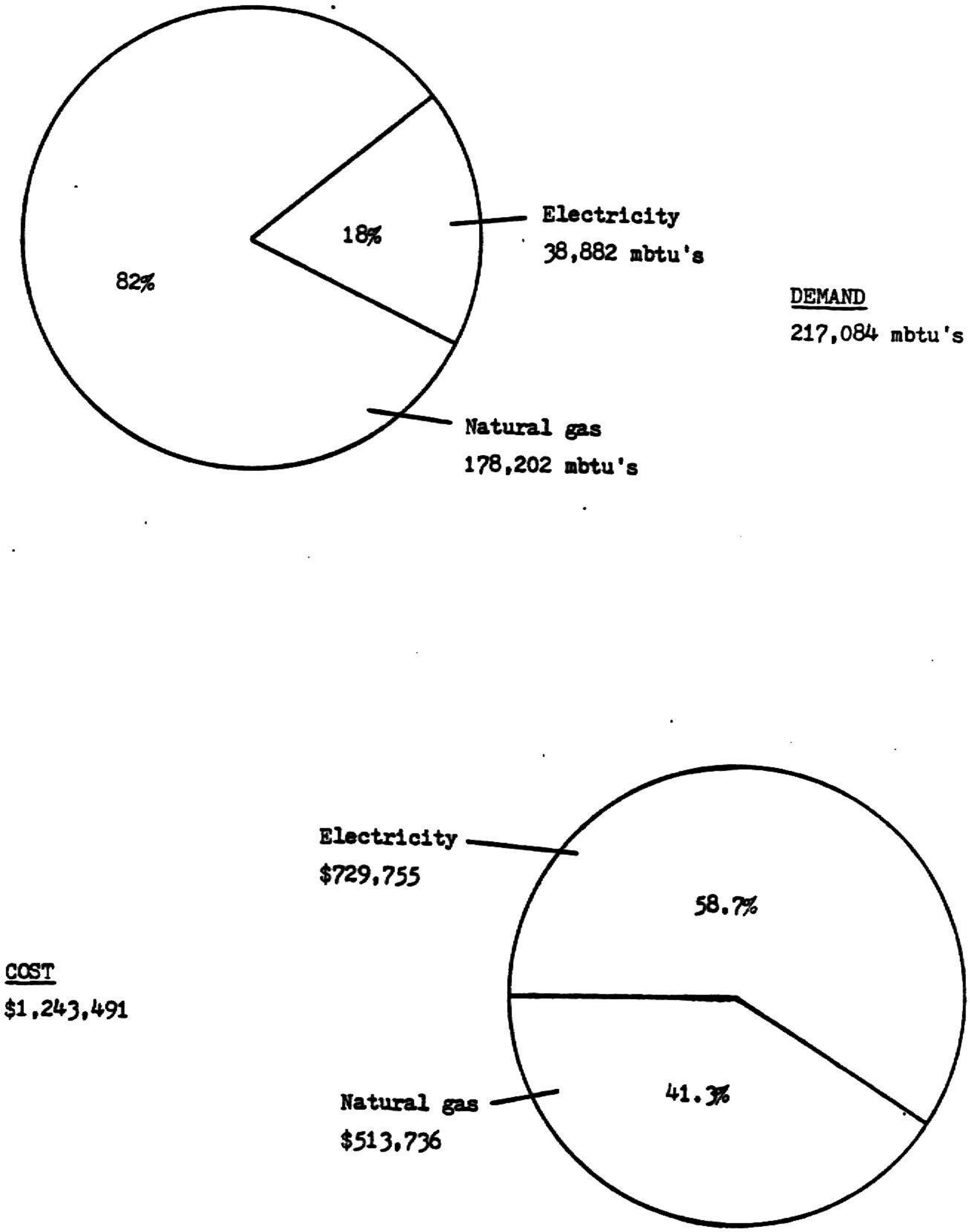

Figure 4: Residential Energy Demand and Cost, 1982

In terms of population characteristics compared to state averages Marysville has 11 percent more persons over the age 65 and 5 percent fewer persons 18 years and under. This may indicate, in terms of energy policy a need for special attention for households with elderly persons, particularly those on fixed incomes. There are fewer persons per household, 2.33 for Marysville as compared with the state average of 2.62, which means about 170 more households in Marysville than would be expected based on the state average.[19] This can be interpreted in two conflicting ways. Fewer persons per household implies less energy demand per household but at the same time means that there are more households for the total population.

2.3.3 Residential Energy Demand By End Use

Space heating consumes 61.5 percent of the total energy demand for the average gas heated residence, compared to 31.5 percent of the total residential energy cost. Residential energy demand by end use is shown in Table 4. The lower percentage for space heating cost is caused by the lower MBTU cost for natural gas as compared to electricity. Therefore electrical end uses have lower percentages of total end use energy demand compared to end use energy costs. For example refrigeration is 3.5 percent of total end use energy but 12 percent of total energy cost. This difference in percentage energy demand and cost reflects the misleading nature of reporting only end use energy, as discussed later in the Energy Economics section. The difference is accounted for in the losses or waste associated with the way most electricity is generated and distributed.

After space heating, cooking is, somewhat surprisingly, the second most costly residential energy end use, since about 83 percent of households use electric ranges.

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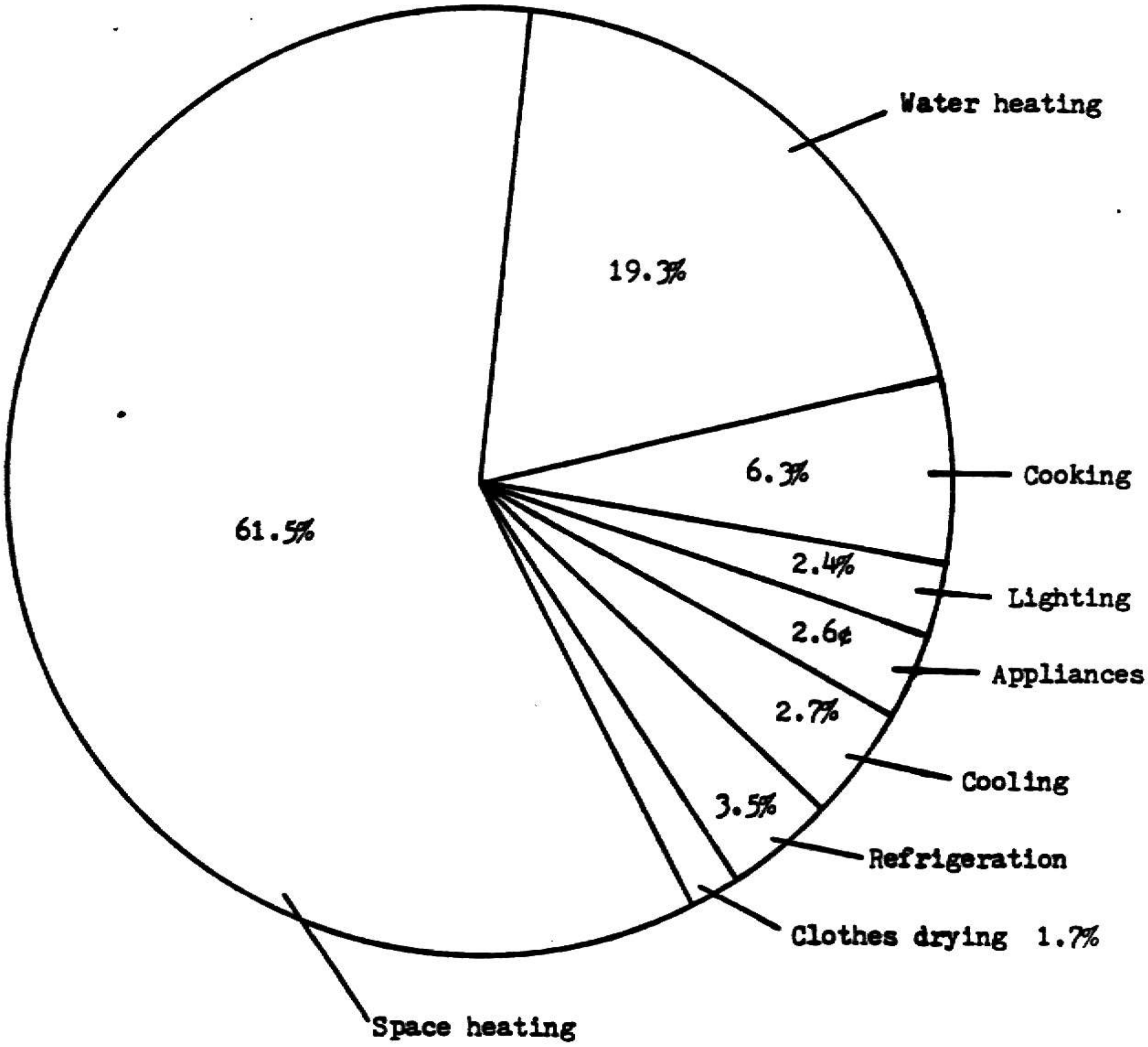
[19] U.S. Department of Commerce, Bureau of the Census, 1980 U.S. Census of Population - General Housing Characteristics vol. 18, Kansas. The average number of persons per household is based on the number of persons in occupied housing units, 3532 persons. The balance of 138 persons that make up the total population reside in places classified as institutions, which are accounted for in the Commercial Sector.



<u>TOTAL DEMAND</u>

223,053 mbtu's

Figure 5: Residential End Use Energy Demand , 1982

TABLE 4

Residential Energy Demand By End Use By Dwelling Type

	Single Family		Multi-Family		Mobile Home		Total	
End Use	N.Gas MBTU	Elec. MBTU	N.Gas MBTU	Elec. MBTU	N.Gas MBTU	Elec. MBTU	N.Gas MBTU	Elec. MBTU
Heat.:								
Space	116,140	2,750	13,464	143	3,338	-	132,942	2,893
Water	37,014	1,185	4,291	62	1,064	-	42,369	1,247
Cook.	2,379	10,415	276	1,150	68	274	2,723	11,839
Refrig.	-	7,108	-	792	-	190	-	8,090
Cool.	-	5,413	-	607	-	146	-	6,166
Appli.	-	5,277	-	588	-	141	-	6,006
Light.	-	4,872	-	543	-	130	-	5,545
Clo.D.	450	2,390	52	265	13	63	515	2,718
Total	155,983	39,410	18,083	4,150	4,483	944	178,549	44,504
Total/ Dwelling Type	(195,393)		(22,233)		(5,427)		(223,053)	

Note: The end use energy in Table 4 was disagregated from totals based on the residential sample survey averages from Table 2. Since the end uses (Table 4) are disagregated by percentages of total demand, the gas heated single family average was used instead of the wood heated single family average which does not reflect actual energy demand (does not include wood energy). Also the difference in the electricity totals in Tables 3 and 4 is explained by the fact the end use percentages used do not precisely match the estimated electricity totals.

2.3.4 Residential End Use Energy Demand By Energy Type

Two types of energy are accounted for in the residential sector, electricity and natural gas. Wood is a third energy type which is important for space heating but has been included with natural gas. It is almost certain that there are other energy types used such as propane or L.P.G. but since they did not occur in the survey sample, these energy types are not disaggregated, but appear as natural gas. These other energy types become much more important outside the urban utility service area. Also not included in this assessment are solar energy contributions to various end uses such as clothes drying and space heating. Only one residence in the survey indicated any kind of special device for collecting solar energy, a greenhouse.

The residential energy survey indicated that 3.6 percent of the sample residences used wood as the primary energy for space heating. It was estimated based on only one survey sample that the potential wood heat contribution to space heating energy demand could be as much as 5970 MBTU. If this is the case wood makes a larger contribution to space heating at 2.7 percent than electricity at 2.1 percent of total residential energy demand. It is difficult to assume that this is an accurate representation of actual wood use based on only one sample residence. For that reason and to simplify calculations, wood energy is included as natural gas energy.

2.3.5 Residential Energy Demand By Dwelling Type

The number of Residential dwelling units by housing type is from the 1980 U.S. Census and is shown below. Single family residences are the most numerous and the largest (square footage) per unit and therefore account for the greatest portion of total energy demand by dwelling type, also shown below.[20]

Housing Type	Number of Occupied Units	Percent of Units	Percent of Total Energy Demand
single family	1282	84.4%	87.6
multifamily	189	12.5	10.0
mobile home	47	3.1	2.4
Total	1518	100%	100%

2.3.6 Residential Energy Use Survey

A summary of the most complete and accurate survey sample data for for detached single family residences with natural gas space heat is shown in Appendix B. The 51 sample residences used earlier to estimate total residential energy demand had only complete metered energy demand records. Each sample house is described in terms of the vertical column headings. Sub-averages are shown for the five house age groups (see Table 1) and then an overall average.

The average construction date for the sample houses is 1929. The average size of heated floor area in the sample is 1370 square feet. Energy demand averages by energy type and demand intensities are shown (meausred as BTU/square foot floor area/degree day for heating and cooling). For the total sample average heating and cooling energy demand intensity factors, two numbers are shown. The upper number for space heating 13.94 BTU/sq. ft./HDD is the

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[20] Ibid.

average of all the individual sample numbers. The lower figure in parentheses, 12.75 is the result of using the total sample average of heated square footage and the average amount of natural gas used for space heating. The difference is attributed to the variation in the relationship of square footage to energy used for the sample cases.

The dwelling characteristic ratings are based on site inspections of the sample residences. Definitions of these characteristics are described in Appendix A. Standards were set for each characteristic such as R-38 insulation values for the attic and R-11 for the walls. A score number of 4 indicates 100 percent of the particular characteristic, or a score number of 2 means 50 percent. The total possible score is 24 for the six characteristics. The average total score is 15.9 or 66 percent of the standard.

There are several sample residences which exhibit an expected pattern. For instance sample number 19 has a relatively low BTU/sq. ft./HDD of 8.78, does not have nighttime thermostat set-back, but does have an expected high dwelling thermal characteristics score of 23. Sample number 24 shows a relatively high BTU/sq. ft./HDD of 22.51 and an expected pattern of high day and night thermostat settings and a low score of 10. There are some sample residences which do not fit the expected pattern so well, such as sample number 13 with a low score number of 14, high thermostat settings, yet with a low BTU/sq. ft./HDD of 6.86. A partial explanation may be that there is only one occupant.

The averages for the individual dwelling characteristics indicate that attic insulation is less than half of the standard R-38. Caulking and weatherstripping are also about half of the standard set. These are the lowest average scores which indicates that efforts to improve these characteristics of the Marysville housing stock could significantly reduce space heating energy demand.

The energy related behavior characteristics are also described in terms of thermostat settings. The approximate daytime setting is 67 degrees and although not all sample homes setback the thermostat at night the average set back is to about 64 degrees. Approximately 8% heating energy is saved with a 5 degree 8-hour nighttime thermostat setback or 12 percent with a 10 degree setback.[21]

The solar suitability characteristics are the result of on-site inspections which assessed a number of factors that indicate the potential effectiveness of solar retrofit applications for space heating or water heating. The space heating potential is based on the amount of solar access of wall area or roof area or both. Water heating potential is based of the amount of roof area only.

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[21] James Morrison, The Kansas Energy Savings Handbook for Homeowners, (New York: Harper & Row, 1979), p. 188.

2.3.7 Behavioral Aspects of Energy Use

Behavior and the attitudes that effect behavior may be as important as any of the other factors that determine energy use. In other words where the thermostat is set, how often and how long the doors are opened to the winter cold or summer heat, or other behavior or lifestyle related factors can be as important as energy features such as insulation. Some of the variation in the survey results may be explained by lifestyle and behavior of the occupants. The attitudes that influence behavior can play an important role in energy conservation that complements engineering solutions. [22]

2.4 COMMERCIAL SECTOR

2.4.1 Methodology

The commercial sector includes energy use for all business activity in Marysville. The diverse collection of buildings and activities is divided into subcategories for assessing energy demand. Since information about commercial activity in a small city like Marysville is very limited it was decided to gather information directly through a survey sample of businesses. The Kansas Department of Economic Development (KDED) was contacted by the Marysville Chamber of Commerce to conduct a Merchants Attitude Survey. In addition to providing a list of businesses by type, KDED officials made it possible to include energy related questions in the standard survey. The KDED survey results are shown in Appendix C.

The KDED survey provided a list of Marysville businesses. Businesses not included were added from the telephone directory to obtain a nearly complete list. This list was divided into commercial subcategories to select sample businesses from each. The sample businesses were then contacted to obtain actual energy demand information. The sample data was then used to estimate total and end use energy demand within each commercial subcategory. The expanded energy demand is based on average energy demand per employee from the the survey sample information. For example, actual energy demand for the 1982 base year was obtained for 8 businesses in the General Retail subcategory. Total employment for these businesses is 30. By converting total energy demand for these businesses to BTU energy units and then dividing by the number of employees , a BTU quantity per employee figure is derived. Then multipling the total number of employee's in the subcategory by the BTU per employee figure for each energy type, a total energy demand for the entire sub-category was estimated. A per unit energy cost by energy type for each subcategory was derived from the sample information.

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[22] Allan R. Edgar, "Occupant/Dwelling Disposition Factor as Predictor of Residential Energy Consuption," (Masters Theses, Kansas State University, May 1983).

Energy demand by end use was estimated based on the sample actual monthly utility metered energy demand record. End use energy demand is particularly difficult to dissagregate for the commercial sector. While the estimates are assumed reasonable, further evaluation, particularly for the larger industrial process and space heating end uses would be adviseable in considering any specific action regarding these end uses.

Of the 139 businesses accounted for, sample energy demand data was obtained for 28 businesses, or 20.1 percent of the total. Two manufacturing businesses that are outside the city limits and 7 businesses in the miscellaneous sub-category were in neither the sample data nor included in the expanded energy demand estimates. The manufacturing businesses outside the city limits are important but because of time limitation were not included. The 7 miscellaneous businesses were felt to be unique enough that at this time no reasonable estimate could be made. Energy demand for the commercial survey sample businesses is shown in Table 5. Expanded energy demand estimate for the total commercial sector is shown in Table 6.

TABLE 5

Commercial Survey Sample Energy Demand Data, 1982

			Electricity		Natural Gas		Total	
	No. of Bus.	No. of Emp.	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $
Manufacturing	4	179	6,649	65,397	7,761	16,388	14,410	81,785
Office Space	5	59	1,124	18,828	834	2,175	1,959	21,003
Service and Other Retail	3	7	116	2,380	453	1,213	569	3,593
General Retail	8	30	435	9,650	1,617	4,092	2,052	13,742
Food Stores	2	30	3,192	41,646	623	1,627	3,815	43,273
Eat/Drink Pl.	1	12	380	5,541	435	1,107	815	6,648
Agri Service	2	16	117	2,501	986	2,451	1,103	4,952
Auto Service	1	5	3	153	104	295	107	448
Construction	1	7	6	199	101	290	106	489
Miscellaneous	1	3	15	375	423	1,092	438	1,467
Motel	0	-	-	-	-	-	-	-
Total	28	348	12,037	146,670	13,335	30,730	25,372	177,400

TABLE 6

Expanded Commercial Sector Total Energy Demand, 1982

Sub-category	No. of Bus.	Emp.	Electricity		Natural Gas		Total	
			Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $
Manufactur.	4	179	6,648	65,397	7,761	16,388	14,409	81,785
Office Sp.	21	148	2,864	47,320	2,087	5,442	4,951	52,762
Service Other Ret.	20	123	2,029	41,787	7,959	21,312	9,988	63,099
General Ret.	33	148	2,146	47,577	7,975	20,184	10,121	67,761
Food Stores	3	46	4,894	63,847	957	2,499	5,851	66,346
Eat/Drink Pl.	12	67	2,210	30,931	2,425	6,174	4,545	37,105
Agri. Ser.	5	54	394	8,428	3,326	8,273	3,720	16,701
Auto Ser.	17	48	32	1,484	995	2,870	1,027	4,354
Construct.	3	29	23	803	417	1,202	441	2,005
Miscellan.	3	24	25	629	704	1,820	729	2,449
Motel	9	11	1,303	2,883	1,252	3,609	2,555	6,492
Total	130	858	22,478	311,086	35,858	89,774	58,337	400,795

2.4.2 Overview

The commercial sector represents 15.7 percent of Marysville's total end use energy demand. Total commercial energy costs were estimated to be $400,800, or 16 percent of the total community energy costs, with electricity accounting for 78 percent of the total cost. Total energy demand and total energy cost by energy type is shown in Figure 7.

The cost and supply of energy in this sector plays a critical role in determining the health and prosperity of the local economy. Energy price increases and interruption in supply can reduce profits, divert capital investments, threaten business operations and cause employment layoffs.

The results of a Merchants Attitude Survey conducted by the Kansas Department of Economic Development, which included approximately 83 percent of the businesses in Marysville, indicated that of

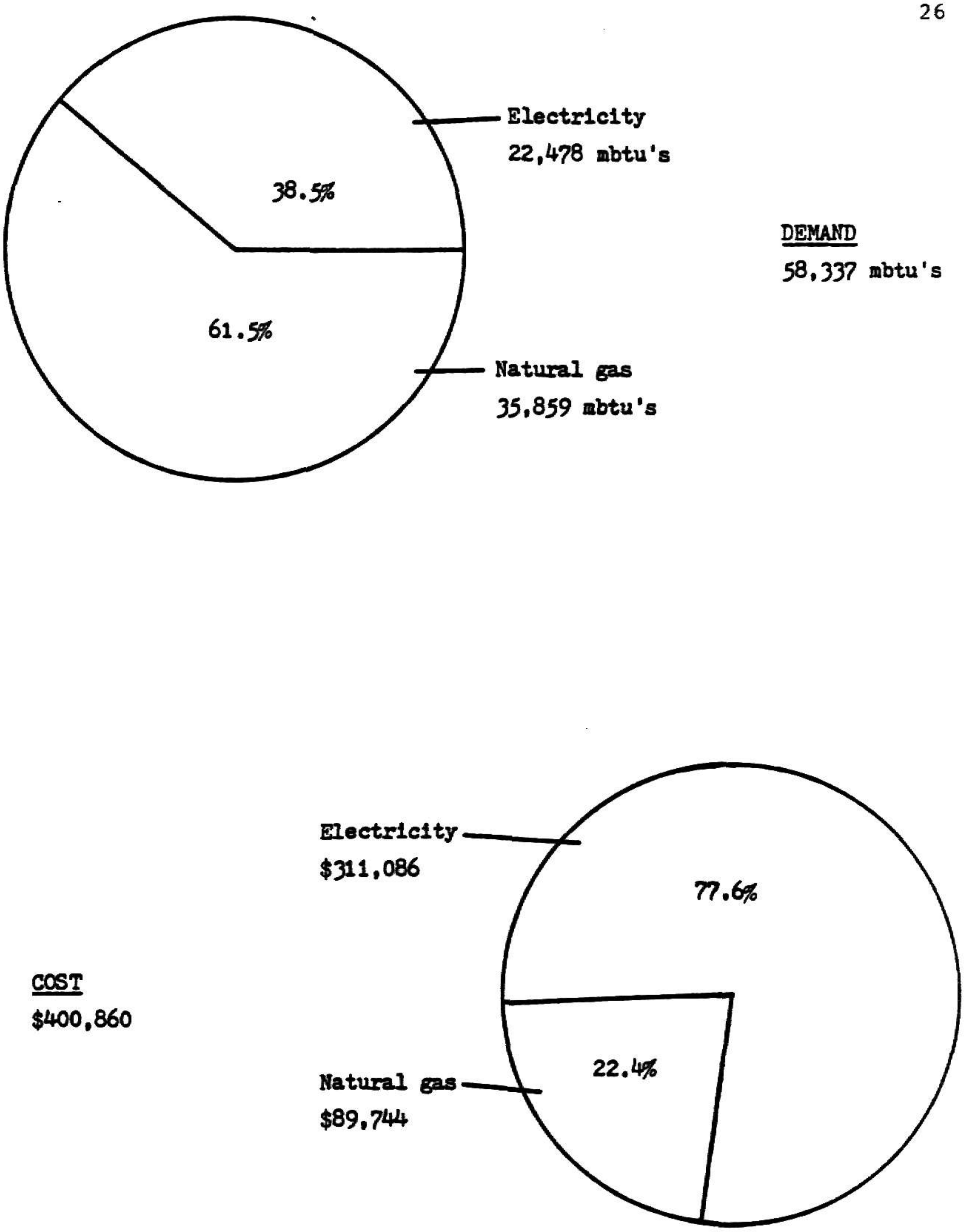

Figure 7: Commercial Energy Demand And Cost, 1982

the businesses surveyed:[23]

1. 98% think that energy costs will continue to rise,
2. 62%, feel they already have been significantly affected by the increased cost of energy.
3. 39%, have some plan to reduce energy costs in the coming year.
4. 81%, feel that outdoor thermal comfort of pedestrians is at least of some importance in attracting customers to shop downtown.

2.4.3 Energy Demand By Sub-category

The largest energy demand sub-category is manufacturing which accounts for 25 percent, and the second largest General Retail, accounts for 17 percent of total commercial end use energy demand, shown in Figure 6.

Energy demand for each commerical sub-category is discussed below. Averages by sub-category for number of employees, energy demand by energy type and cost are shown in Table 7.

2.4.3.1 Manufacturing

Only four businesses are accounted for in this, the largest commercial sub-category in terms of number of employees and total energy demand and cost. These businesses account for 25 percent of the total commercial energy demand, or 4 percent of the total community energy demand. Energy demand is divided between electricity, 46 percent and natural gas, 54 percent. Electricity accounts for the largest portion of total energy cost, $65,397 or 80 percent of manufacturing energy cost. The per unit electrical price is the lowest of any sub-category, 3.35 ¢/Kwh almost one fifth the 15.8 ¢/Kwh price paid by the smallest commercial customer. The per unit prices for both electricity and natural gas paid by these businesses are the lowest in the commercial sector and any other sector.

The manufacturing businesses can be distinguished from the other sub-categories, which are retail/service oriented, in that raw materials are converted into goods for sale outside the area. Manufacturing is often thought of in terms of the ratio of energy input per unit of output (goods). While the amount of energy may remain

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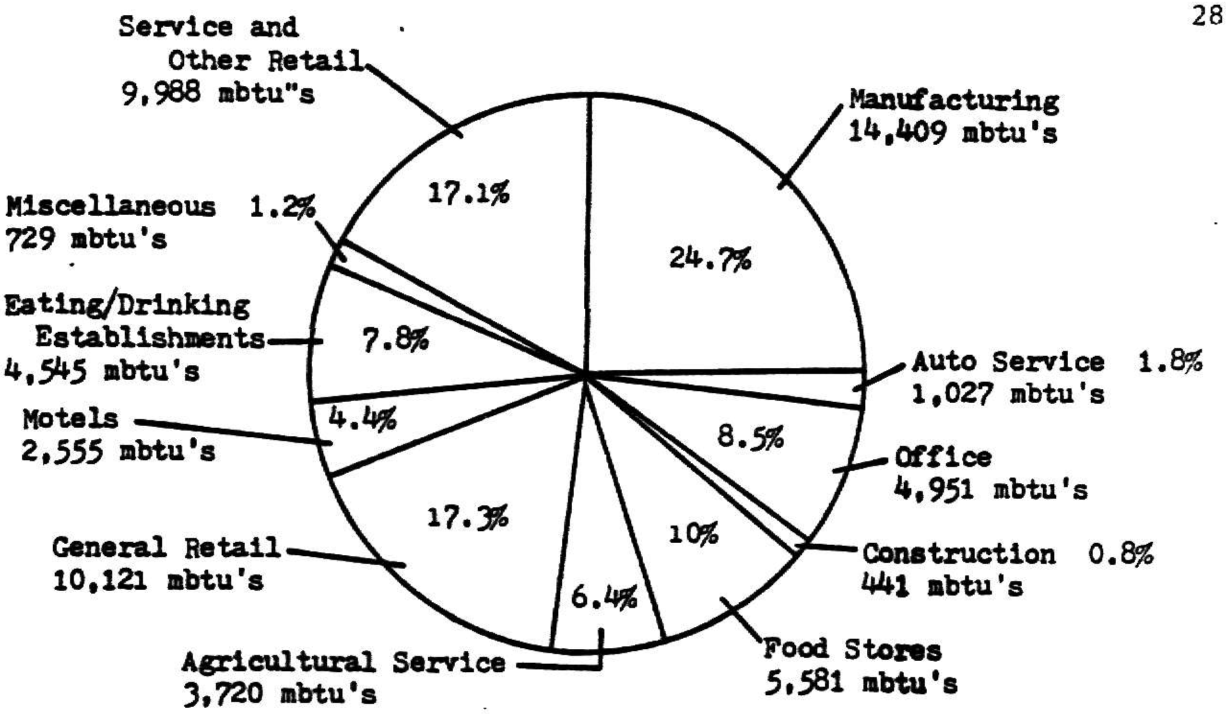
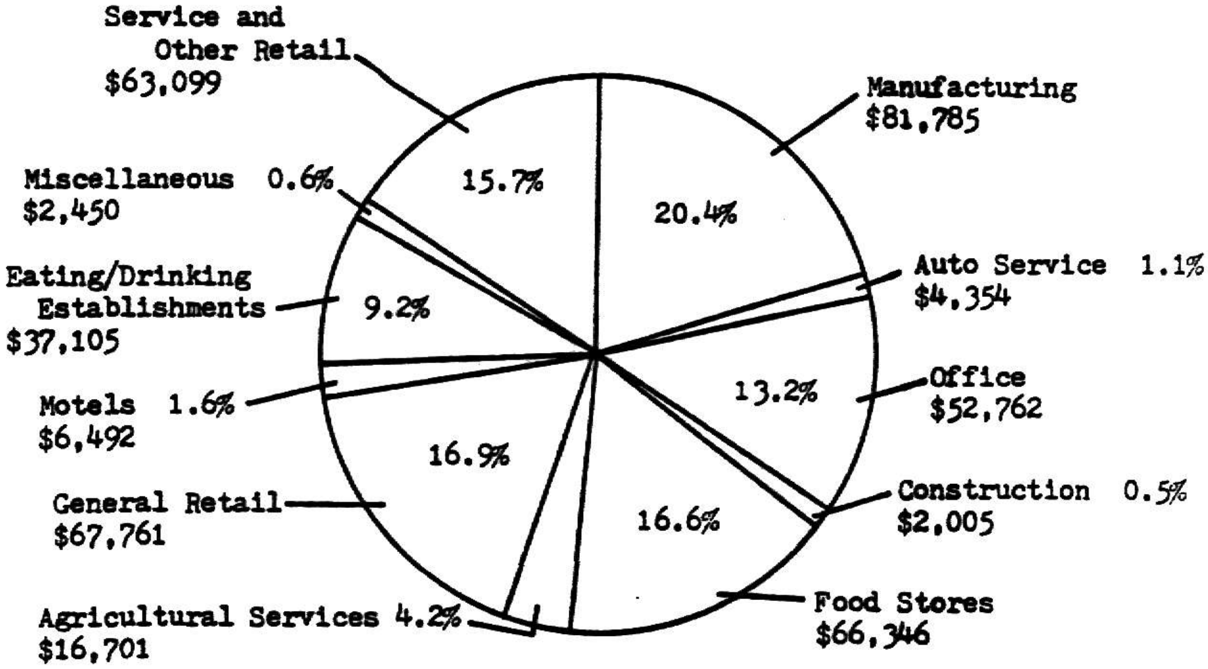
[23] Kansas Department of Economic Development, Merchants Attitude Survey- Marysville, Kansas, Dec. 1982.



TOTAL DEMAND

58,337 mbtu's



TOTAL COST

$400,860

Figure 6: Commercial Energy Demand And Cost By Sub-Category

TABLE 7

Commercial Sub-category Energy Demand Averages, 1982

		Electricity		Natural Gas		Total	
Sub-category	no. Emp.	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $
Manufact.	45	1,662	16,349	1,940	4,097	3,602	20,446
Office Sp.	7	136	2,235	99	259	235	2,512
Service and Other Ret.	5	33	680	129	347	162	1,027
General Ret.	6	101	2,089	241	611	342	2,700
Food Stores	15	1,631	21,283	319	833	1,950	22,115
Eat/Drink Pl.	6	177	2,577	202	514	379	3,092
Agri. Ser.	11	79	1,685	665	1,655	744	3,340
Auto Ser.	3	2	87	58	169	60	256
Construct.	10	8	268	139	400	147	668
Miscellan.	2	8	210	235	607	243	816
Motel	1	145	2,111	139	400	284	2,511

constant for producing a particular item, energy price increases are reflected in the cost of the raw material inputs and in the direct energy inputs required for manufacturing the item. Compounding the energy cost problem is the fact that labor has been increasingly replaced by energy consuming equipment. Therefore production process and product innovations which improve energy use efficiency can maintain or improve price competiveness.

After Space Heating, the special industrial processes are the largest energy consuming end uses. The manufacturers in Marysville include printing, farm machinery manufacturing, paper related products and beverage bottling. Because of the diversity of end uses among the businesses further detail about the end uses is not reported here.

2.4.3.2 Office Space, Service and Other Retail

These sub-categories are grouped here because they have similar end uses. Together these sub-categories account for 42 percent of the commercial sector energy demand or 6.8 percent of the total community energy demand. In terms of cost this groups accounts for percent of the total commercial energy costs or percent of the total community energy costs.

As indicated in Table 7 the Office Space subcategory has the higher electrical demand average for this group of sub-categories which may be attributed to electric heating, higher lighting and use of various electrical equipment that occurred in the sample businesses. National research indicates that commerical buildings are grossly over-lighted. Lighting standards, set earlier by industries promoting lighting products, have led to saturation lighting (lighting every corner of the room) which can waste up to 50 percent of the energy actually required for lighting tasks. Also lighting can contribute to the summer cooling load as much as 50 percent.[24]

General Retail has the largest natural gas demand which is probably due to the fact that most of these buildings are older, which could mean older less efficient heating systems, less insulation, etc. Also most of these building have large floor square footage area and high ceilings, where the heated air collects, leaving the lower occupied space with cooler air temperatures, leading to a situation in which thermostats call for more heat to maintain human comfort.

A rough estimate of energy demand for the Community Hospital, based on the average energy demand per employee for the Service and Other Retail sub-category is included in the total Commercial Sector energy demand for that sub- category.

2.4.3.3 Food Stores

The three food stores included in this sub-category represent 10 percent of the commercial energy demand or 1.7 percent of the total community energy demand. Following the Manufacturing sub-category Food Stores have the highest average total energy demand. The following is an example of end use energy for food stores.[25]

End Use		Percent
Refrigeration	--	55.6%
Miscellaneous	--	20.4%
Lighting	--	15.8%
Space heating	--	3.2%

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[24] John Gibbons and William Chandler, Energy: The Conservation Revolution (New York: Plenum Press,1981), p. 178.

[25] Manhattan Area Energy Alliance, Riley County Energy Project Report, prepared for the Riley County (Kansas) Commission, Oct. 1982, p. 6-7.

Hot water -- .4%
100%

An example of cogeneration or recycling of waste heat was evident in one of the sampled food stores (Newmans Jack and Jill) that had installed a heat reclaiming system on the refrigeration units to supply space heating, thereby reducing by approximately half the natural gas needed for space heating.

2.4.3.4 Eating and Drinking Places

The twelve establishments included here account for 8 percent of the total commercial energy demand or about 1.2 percent of the community total energy demand. In terms of energy costs this group accounts for 7.8 percent of the total commercial energy costs and 1.5 percent of the total community energy costs. End use energy can be accounted for in the following example.[26]

End Use		Percent
Food Preparation	--	45.1%
Heating, Air Conditioning and Ventilation	--	32.1%
Sanitation	--	12.6%
Lighting	--	8.2%
Refrigeration	--	2.0%
		100%

2.4.3.5 Agricultural Service and Implement Dealers

The five businesses included in this sub-category primarily sell and service agricultural equipment and account for 6.5 percent of the commerical energy demand. The higher natural gas demand can be accounted for in the heating of large sales, workshop and storage areas. Here again, most of the businesses are in large single floor buildings which are often well suited for space heating solar applications as well as daylighting which could save electrical energy in lighting as well as air conditioning.

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[26] Ibid., pp. 6 - 7.

2.4.3.6 Auto Service, Construction, Miscellaneous and Motel

Together these four sub-categories account for 8.2 percent of the commercial energy demand and 24.6 percent of the total number of businesses (32). These sub-categories are grouped here since they are all relatively small in terms of average number of employees and less energy intensive in terms of average total energy demand (MBTU) per business. Auto service stations have the lowest average total energy demand among these four subcategories and for all commercial subcategories.

A variety of different kinds of businesses are included in the miscellaneous sub-category, but only laundry and cleaning businesses, which occured in the sample, are included here for energy demand averages and totals.

The construction sub-category includes only the energy demand of the business office. Actual construction activities would increase energy demand and include additional energy types such as gasoline and diesel fuel.

2.4.4 Energy Demand By End Use

An estimate of end use energy demand for the commercial sector is shown in Figure 8. Space heating accounts for 40 percent, the largest single portion of end use energy demand. Most of this space heating energy is consumed in the large number of downtown businesses in the General Retail, Office Space and Service and Other Retail Sub-categories. The second largest end use is industrial processes in the Manufacturing sub-category.

An estimate of energy demand by end use by sub-category is shown in Table 9. The figures shown should be considered as rough estimates only particularly for manufacturing and miscellaneous sub-categories.

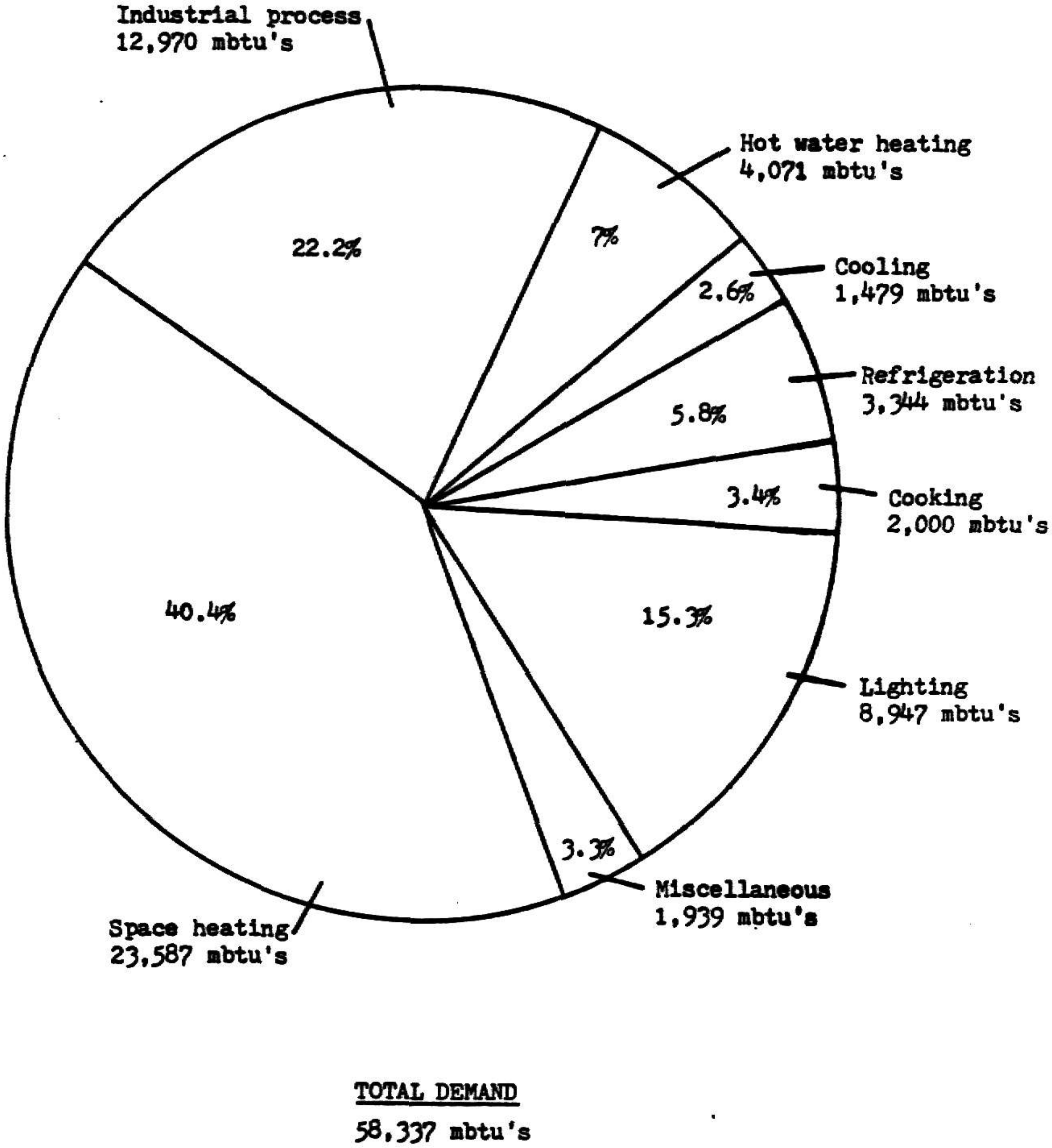

Figure 8: Commercial End Use Energy Demand, 1982

TABLE 9

Commercial End Use Energy Demand By Sub-category, 1982

	Heating						
Sub-category	Space MBTU	Water MBTU	Cool. MBTU	Light. MBTU	Refriq. MBTU	Cook. MBTU	Ind.Pro. MBTU
Manufacturing	720	-		720	-	-	12,969
Office Space	2,030	198	247	2,475	-	-	-
Service and Other Retail	6,292	1,658	400	1,638	-	-	
General Retail	6,983	961	415	1,761	-	-	-
Food Stores	269	23	187	924	3,253	-	-
Eat/Drink Pl.	1,363	545	91	454	91	2000	-
Agri. Service	3,050	160	34	402	-	-	-
Auto Service	873	82	-	72	-	-	-
Construction	363	20	4	48	-	-	-
Miscellaneous	36	-	-	36	-	-	-
Motel	1,609	425	102	419	-	-	-
Total	23,587	4,071	1,479	8,947	3,344	2,000	12,970

2.5 MUNICIPAL SECTOR

2.5.1 Methodology

Energy consumption reported for the municipal sector is based on city records of utility billings. City officials and operations managers provided further information. This sector and the Schools Sector can be considered the most accurate, because they are based on energy demand information for all of the sector components or end uses, rather than being expanded from a sector sample.

Municipal energy demand is divided into three end use sub-categories - buildings, operations, and vehicles and is summarized in Table 10.

2.5.2 Overview

The Municipal sector includes all city buildings and operations, and in a sense performs the "household functions" of a community by providing essential services such as waste collection and treatment, water supply, street lighting, fire protection and law enforcement. While the Municipal sector accounts for less than 3 percent of Marysville's total energy demand, the importance of this sector should not be underestimated. The representative nature of local government necessitates accountability, particularly in the use of limited resources with constantly rising prices.

Marysville 1982 Municipal energy costs account for about 8.5 percent of the total city budget.[27] As energy costs escalate, energy will account for a larger and larger share of what is probably an already strained budget. Municipal energy demand and cost, by energy type, are shown in Figure 9. Municipal energy by end use category is shown in Figure 10.

TABLE 10

Municipal Energy Demand Summary, 1982

	Electricity		Natural Gas		Gasoline		Total	
Sub-category	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $
Buildings	579	8,090	1,886	4,470	-	-	2,465	12,560
Operations	4,433	74,345	578	1,376	-	-	5,011	75,721
Vehicles	-	-	-	-	2,303	21,389	2,303	21,389
Total	5,012	82,435	2,464	5,846	2,303	21,389	9,779	109,670

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[27] Marysville city budget information was provided by city hall. The budget total is $1,292,213 and is actually an average of 1982 actual and the estimated budget for 1982.

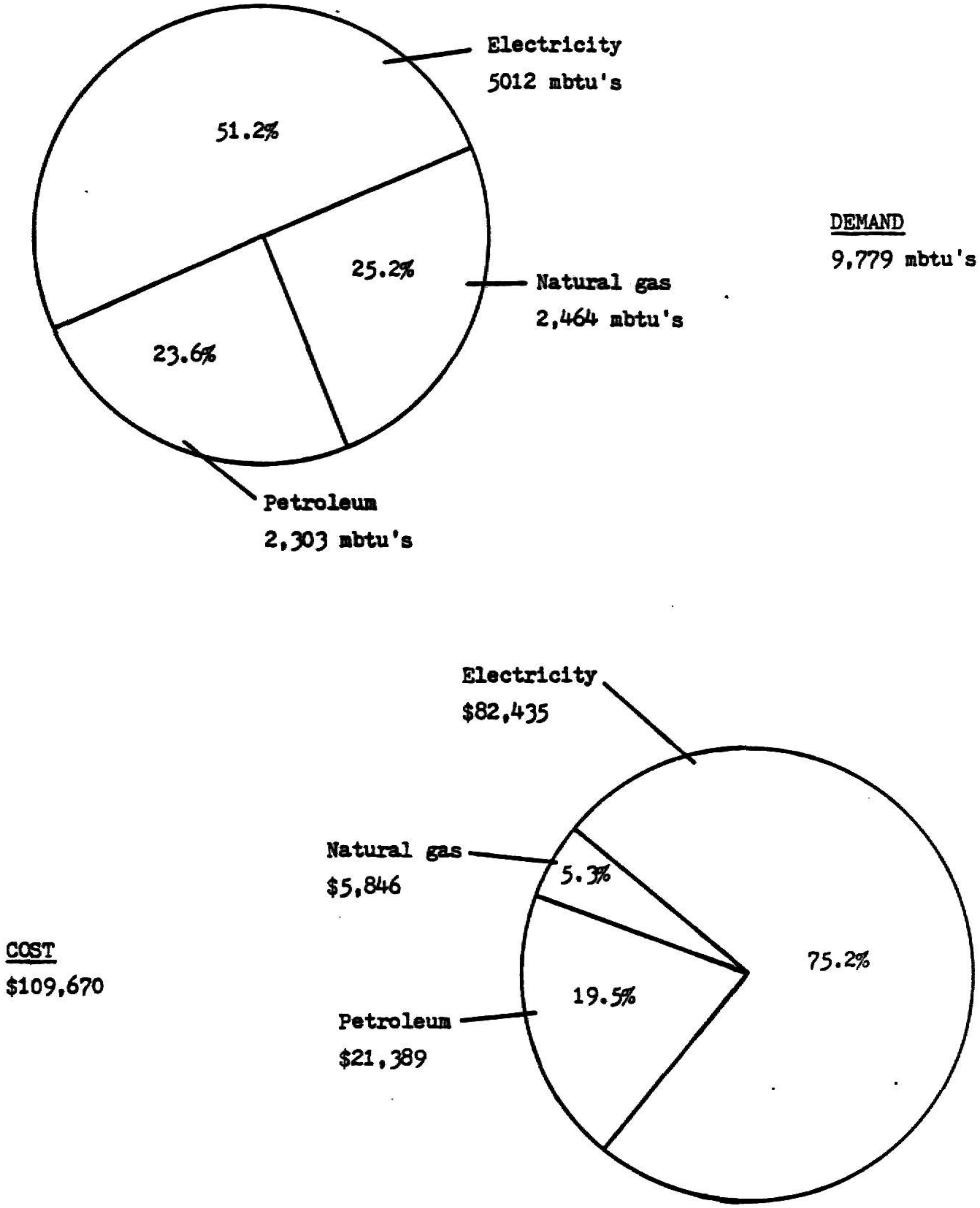

Figure 9: Municipal Energy Demand and Cost, 1982

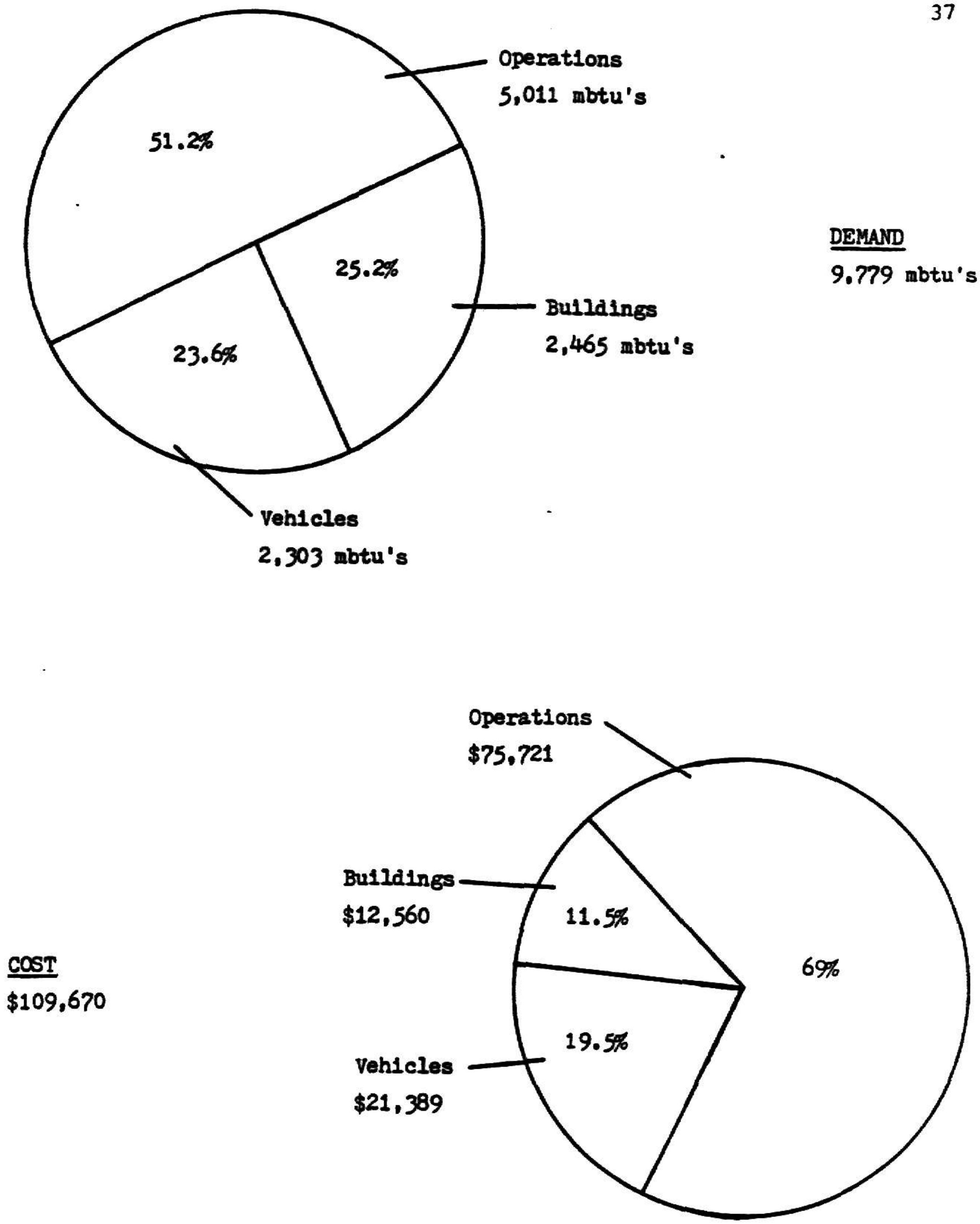

Figure 10: Municipal Energy Demand and Cost By End Use Subcategory

2.5.3 Municipal Buildings Energy Demand

Ten city buildings are included which account for 25.2 percent of the Total Municipal energy demand. The primary end uses within these buildings are - space heating, space cooling, lighting and other electrical uses.

End use energy for three major municipal buildings is shown below in Table 11. The method used to disaggregate end use energy did not allow for further end use disagregation in the all electric city hall. Space heating, lighting and other electricial end use for appliances and equipment are the primary end uses for Municipal Buildings.

TABLE 11

Municipal Buildings End Use Energy Demand, 1982

	Space Heating		Water Heating		Cooling	Light./Other
Building	Nat. Gas MBTU	Elec. MBTU	Nat. Gas MBTU	Elec. MBTU	Elec. MBTU	Elec. MBTU
City Hall	-	173	(............ 270			.............)
Warehouse	758	-	36	-	-	54
Police	368	-	12	-	19	50

There is wide variation in age and condition of the buildings as indicated by the BTU/square foot/Heating degree day index, shown below:

Building		BTU/Sq. Ft./HDD
City Hall	-	3.6
Police Building	-	23.3
Warehouse	-	54.6

The city hall building has the lowest index figure which reflects the higher end use energy efficiency for electric space heating. The city hall building is relatively new (mid 1970's) and has greater insulation values. The higher figure for the police building may be partially attributed to more continuous daily use. The warehouse figure is unusually high and indicates a priority for further evaluation as to why the space heating intensity is twice the next closest figure.

Total energy demand and cost for buildings is shown in table 12. It is important to note that while the all electric city hall building appears to be relatively energy efficient, especially for space heating as indicated above, the end use electric energy does not include the primary or coal energy used to provide the electric energy. This difference between end use and primary energy is reflected in the higher energy cost for the city hall.

2.5.4 Municipal Operations Energy Demand

Included in the municipal operations energy demand sub-category are the water supply and sewer systems, airport, city swimming pool, street lighting and other outdoor lighting. Operations energy demand and cost is shown in Table 12. Total end use energy for operations accounts for 51 percent of the total municipal energy demand and almost 70 percent of the municipal energy cost, since nearly all the the operations energy demand is electricity.

Water supply and sewer system operations utilize more end use energy than any other operation or building. Electricity is used to pump freshwater from the river to treatment, to storage and to final use in households and businesses throughout the community. Waste water and sewage flows most of the distance to treatment by gravity, but at several points (lift stations) it must be pumped.

Daily and seasonal fluctuations in water use cause peaking in capacity for both freshwater treatment and pumping water through the distribution system. The daily water demand peaks are in the morning and evening. Seasonally, winter is the low and summer is the high water demand period.

An interesting relationship between air conditioning, which is solely dependent on electricity, and high summer water use, reveals a special vulnerability to excessive electrical demand in the summer which can cause brownouts or even blackouts. This capacity for meeting peak electrical energy demand has been built into large power plants. Much of the time this excess generation capacity must sit idle. These are some of the reasons that influence electrical price rates.[28]

Streetlighting is the largest single energy demand and cost component of the Municipal sector accounting for 18 percent of the Municipal energy demand and 33 percent of the total energy cost (in addition to direct energy cost, included is a relatively small cost for service and maintenence charges).

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[28] For more information on generation of electric energy in Kansas see Kansas Energy pp. 35 -47.

2.5.5 Municipal Vehicles Energy Demand

The city owns and operates a variety of vehicles for administrative, service and maintenence functions. The following is a profile list of vehicles by vehicle type:

Vehicle Type		Number
Police cars	-	2
Pick-up trucks	-	6
Tractors	-	5
Motor graders	-	3
Dump trucks	-	3
Street Cleaner	-	1
Riding Lawn Mower	-	4

Gasoline and diesel use for these vehicles account for 23.5 percent of Municipal energy demand and 19.5 percent of the cost.

Municipal energy demand and cost is detailed in Table 12.

TABLE 12

Municipal Energy Demand and Cost, 1982

Buildings

	Area	Elec		Natural Gas		Total	
		Demand	Cost	Demand	Cost	Demand	Cost
	Sq.Ft.	MBTU	$	MBTU	$	MBTU	$
City Hall	7,672	444	5,958	-	-	444	5,958
Warehouse	5,390	54	732	794	1,889	848	2,621
Police	880	49	774	400	962	449	1,736
Pony Express	2,000	11	209	89	213	100	422
Fire Station #1	-	9	124	192	456	201	580
#2	-	4	46	-	-	4	46
#3	-	6	79	120	279	126	358
Other		2	168	291	671	293	839
Total		579	8,090	1,886	4,470	2,465	12,560
Operations							
Sewage Disposal		714	10,072	110	265	824	10,337
Water Supply		1,508	21,307	468	1,112	1,977	22,418
Misc Outdoor Lighting		196	2,905	-	-	196	2,905
City Pool		100	1,690	-	-	100	1,690
Airport		109	1,416	-	-	109	1,690
Street Lighting		1,740	36,000	-	-	1,740	36,000
Signal Lights		66	955	-	-	66	955
Total		4,433	74,345	578	1,376	5,011	75,721

Vehicles & Equipment

Fuel Type	Gallons	MBTU	Cost $
Gasoline			
Regular	7,909	990	9,095
Unleaded	8,759	1,095	10,511
Diesel	1,621	219	1,783
Total	18,289	2,303	21,389

2.6 SCHOOLS

2.6.1 Methodology

Four schools of the Marysville Unified School District 364 are included in the sector. The only other school in the district (located in nearby Beattie) is not included. Energy for the buildings is supplied by the local utility. Energy demand records for the buildings were obtained from the utility through the school district administrators. Fuel consumption for busing of students, floor area of buildings and school budget information was also provided by the school district office. School Sector energy demand is detailed in Table &schtab..

2.6.2 Overview

The Marysville public schools are a separate local governmental unit and are considered here as a sector. The issue of energy costs in local schools has become a matter of considerable community interest, affecting not only the quality of educational experience but also school budgets and local property taxes. While energy costs account for approimately 3.1 percent of the school district budget, there is little flexibility in allocations. As energy costs continue to rise in an era of limited educational resources, energy management will become an increasingly important part of the overall reponsiblity in the planning and operation of the local schools.

Natural gas, used primarily for space heating in buildings, accounts for the largest portion, 61 percent, of the total energy demand and 27 percent of total energy cost for the Schools Sector, as shown in Figure 11. Gasoline used for busing accounts for the largest energy cost, $46,744 or 46 percent of the total energy cost.

2.6.3 School Buildings Energy Demand

Total energy demand by school building is shown in Table &schtab. The Junior High School which has the largest square footage area and the largest enrollment, has the largest energy demand.

A comparison of estimates for space heating energy efficiency, BTU/square foot/heating degree day, for the school buildings is shown in Figure 12. The newer High School and Junior High School buildings have the lowest values, indicating greater insulation values and more efficient heating systems. However site visits suggest that Central and Lincoln schools could achieve comparable efficiences through a variety of cost-effective "housekeeping" improvements.

2.6.4 Vehicles

The energy used for busing students to and from schools accounts for 28.4 percent of the total School Sector energy demand. Included here are the total number of busing miles for the school district. In the final tally of energy demand and cost for the Marysville sectors, the fuel demand for busing is not seperated out since the method used for estimating the Transportation Sector energy demand includes part of the energy used for busing and it is not possible here to completely disaggregate busing from other transportation.

Energy costs for busing account for 46 percent of the Schools sector total energy costs. Part of the reason for this high busing cost is the consolidation of smaller schools, that were often located closer to students, into unified school districts.

Energy demand details concerning vehicles used for busing are shown below.

Busing miles traveled	323,726
Gallons of fuel	42,236
MBTU	(5,282)
Total cost	$46,774

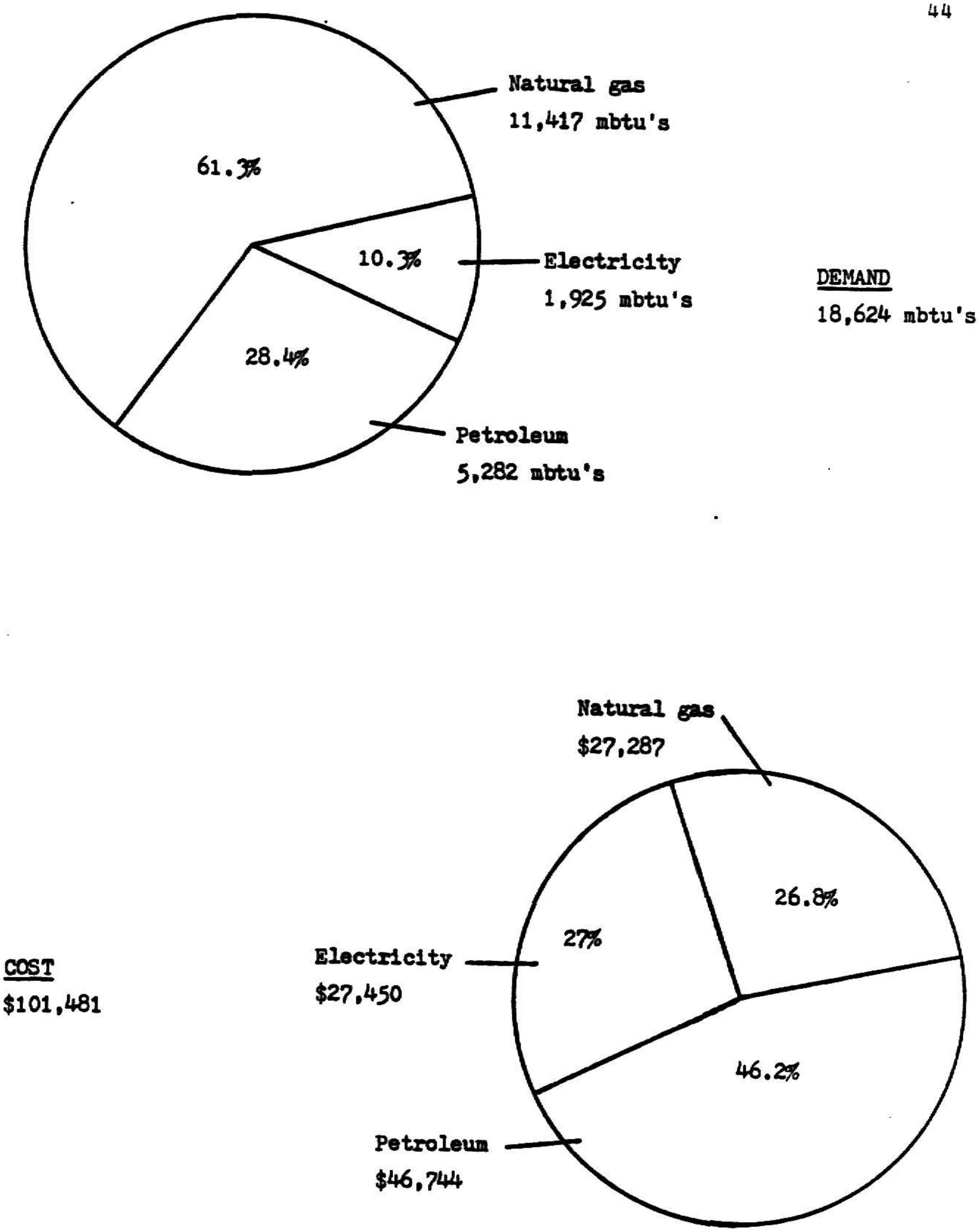

Figure 11: Schools Energy Demand And Cost, 1982

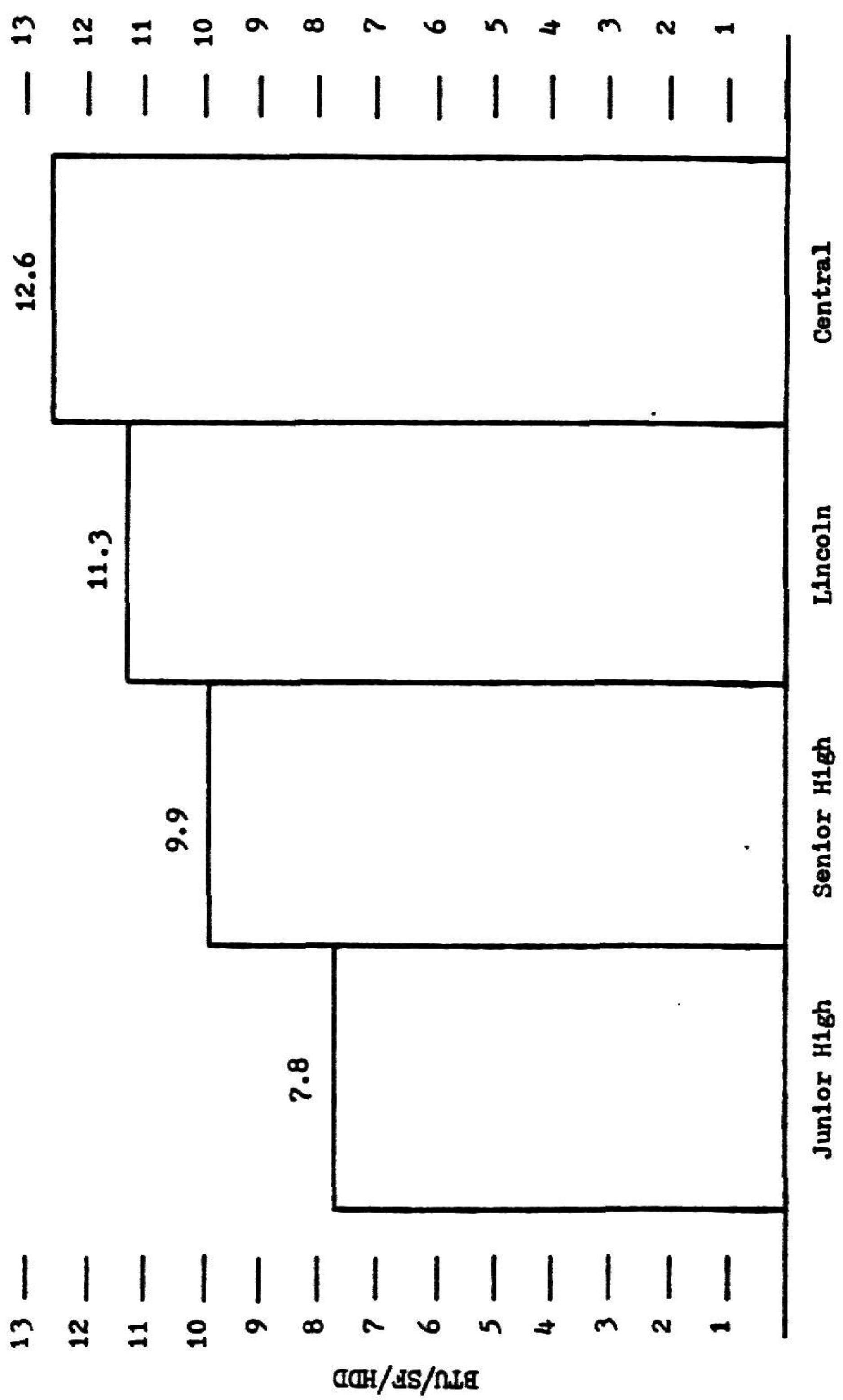

Figure 12: School Buildings Energy Efficiency Comparison

TABLE 13

Schools Energy Demand and Cost Summary, 1982

		Electricity		Natural Gas		Gasoline		Total	
School	Area Sq.Ft.	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $	Demand MBTU	Cost $
Hi Sch.	45,641	646	8,974	2,851	6,770	-	-	3,497	15,744
Jr High	64,786	893	11,775	3,594	8,536	-	-	4,487	20,311
Central	28,100	172	2,750	2,134	5,102	-	-	2,306	7,852
Lincoln	16,000	128	2,088	1,130	2,807	-	-	1,258	4,895
Other	-	86	1,700	1,708	4,235	-	-	1,794	5,935
Busing	-	-	-	-	-	5,282	46,744	5,282	46,744
Total		1,925	27,450	11,417	27,287	5,282	46,744	18,624	101,481

2.7 TRANSPORTATION SECTOR

2.7.1 Methodology

Transportation energy demand is a function of vehicle miles of travel (VMT) and vehicle fuel efficiency (MPG). Marysville VMT is based on 1981 data from the Kansas Department of Transportation.[29] The total VMT is apportioned by vehicle type based on the percentage distribution of the number of vehicles by type.[30] For example since 28.6 percent of all vehicles are light trucks 28.6 percent of the total VMT is for light trucks. Actual VMT maybe different, but for purposes of this study it is felt to be a reasonable estimate. The vehicle inventory was obtained from information provided by the county sheriff's office. The MPG values for each vehicle type are from a Kansas Department of Transportation report, _1980 Kansas Profile of Motor Fuel Consumption_.

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[29] 1981 Daily vehicle miles traveled = 20,823, multiplied by 365 (the number of days in a year) = 7,600,395.

[30] The motorcycle percentage of all vehicles (5.2) is divided in half to account for seasonal use. The remainder percentage is attributed to autos.

2.7.2 Overview

Much of Marysville social and economic activity involves accessibility and cost of transporting people and goods within and between Marysville and the rest of our economic world. Based on the total annual number of vehicle miles traveled in Marysville, transportation energy demand for passenger vehicles and trucks is estimated to be 604,185 gallons of gasoline and diesel, accounting for 18.4 percent of the total community energy demand and 28.3 percent of total energy costs. Average household transportation energy demand is 335 gallons and average cost of 402 dollars for travel in the city of Marysville.

For purposes of this study energy demand was limited to travel within the city, though transportation energy demand analysis on the local level is somewhat misleading, in that not all transportation energy demand is accounted for. Small town and rural areas are especially dependent on vehicle transportation for personal and recreational needs, to import household and commercial supplies and to export agricultural and manufactured products. Based of state data, an alternative method of estimating Marysville transportation energy demand and cost indicate that total demand would account for 48 percent of community energy demand and 80 percent of total energy cost. The alternative average household energy demand is 1,438 gallons and $1,726.

Autos and light trucks account for 85 percent of the transportation energy demand shown in Figure 13 Of all the sectors studied, transportation is the most dependent on only one energy type - oil, as shown also in Figure 13.

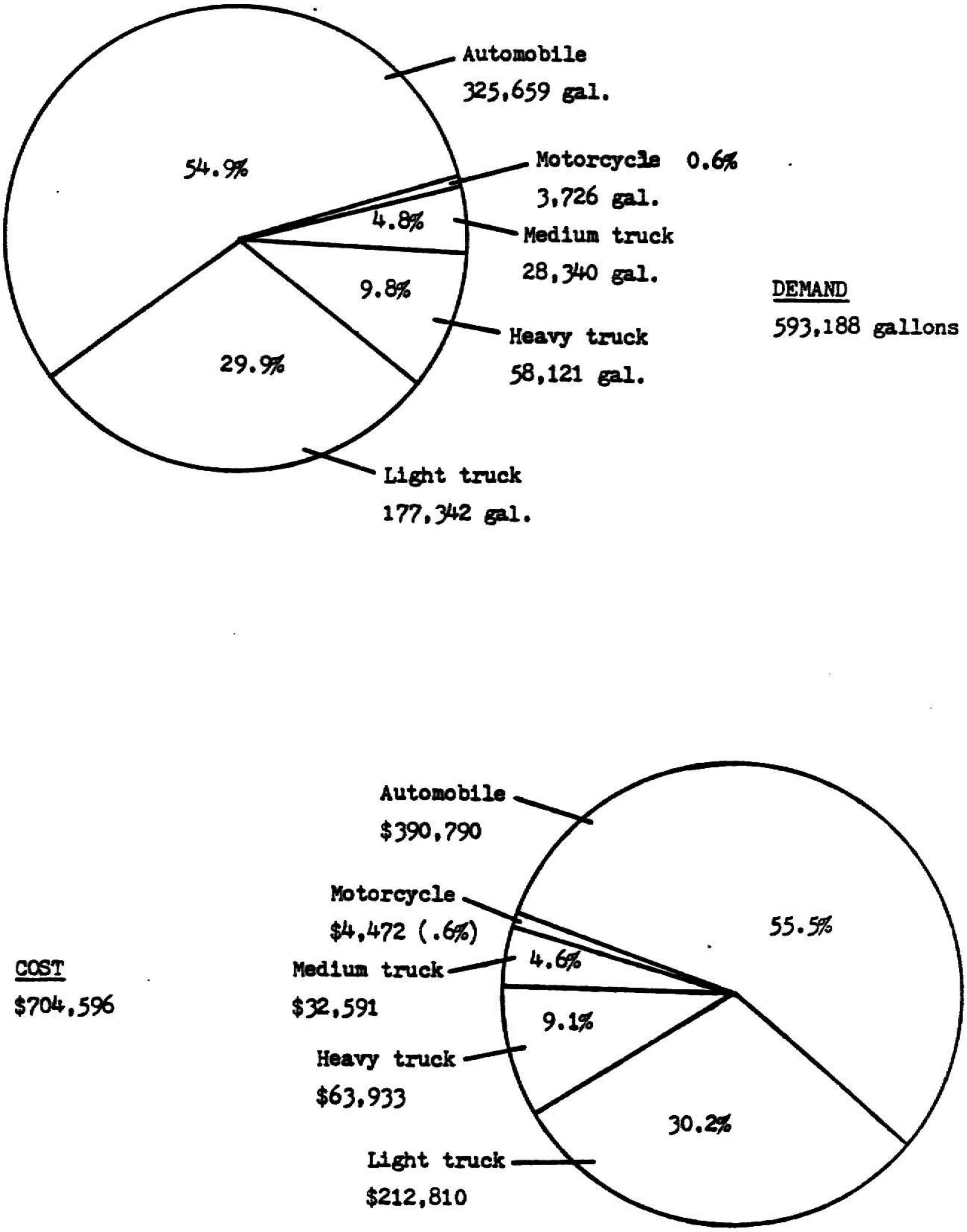

Figure 13: Transportation Energy Demand and Cost by Vehicle Type

2.7.3 Vehicle Inventory

The number of vehicles by vehicle type in Marysville is presented below in Table 14. Passenger autos account for the largest share of the total number of vehicle at 62.1 percent and light trucks which account for much of the passenger transportation, as opposed to transporting cargo, account for 28 percent of the vehicles.

TABLE 14

Vehicle Inventory Profile, Marysville, Ks. 1982

Vehicle Type	Number	Percent
Auto	3,459	62.1%
Light Truck	1,562	28.0
Medium Truck	122	2.2
Heavy Truck	147	2.6
Motorcycle	283	5.1
Total	5,573	100%

A comparison of average number of vehicles per household between the state and Marysville indicates the higher dependence on autos and trucks in Marysville for personal mobility and economic activity.

	Marysville	Kansas
Average number of autos per household	2.3	1.4
Average number of all vehicles per household ..	3.7	2.3

It is also interesting to note that there are nearly twice the number of motorcycles per 1000 people in Marysville, 70 motorcycles per 1000 people compared to 40 motorcycles per 1000 people for the whole state.

2.7.4 Vehicle Energy Efficiency

Auto fuel efficiency (MPG) for new model cars has increased dramaticaly since 1974 when average (sales weighted) MPG for U.S. domestic autos was about 14 MPG. Foreign and domestic new car model average for 1982 is 26 MPG. The age of the community's vehicle stock is therefore an important factor in transportation energy efficiency. Auto model-year distribution of the Marysville auto vehicle stock is shown below in table 15. The percentage of pre 1974 autos is over 44 percent. The average auto model year is approximately 1977. The auto model-year profile does not necessarily indicate how much each auto model-year is driven.

TABLE 15

Auto Model-Year Distribution

Model-Year	Percent	Model-Year	Percent
1960 and older	1.9%	71	5.1%
61	.4	72	6.7
62	1.4	73	8.5
63	1.6	74	5.7
64	1.7	75	5.7
65	2.4	76	7.9
66	2.9	77	9.2
67	2.4	78	8.0
68	3.0	79	9.0
69	1.4	80	5.0
70	4.2	81	2.1
		82	1.2

It is important to emphasize the relationship between vehicle miles of travel (VMT) and vehile fuel efficiency (MPG). Statewide the number of annual vehicle miles traveled per capita has increased at a rate of about 2 percent per year as shown below. as shown below:

Year	Kansas per capita VMT
1970	5900
1975	6700
1980	7300

Therefore increasing VMT may offset energy savings from increased vehicle fuel efficiency (MPG).

Transportation energy demand estimates for travel in the city of Marysville are detailed in Table 16. School bus and Municipal vehicle travel are included in the VMT for this sector.

The number of diesel gallons is based on state percentage of diesel mix. All heavy truck and half of medium truck fuel is assumed to be diesel. Fuel cost averages are; gasoline=$1.20/gallon and diesel=$1.10/gallon.

As a check, another method of estimating Marysville transportation energy was used. This Method is based on fuel sales of Marysville fuel distributors from the Kansas Department of Revenue Motor Fuel Gallonage Report. The reported sales in gallons were 20 percent more than what is estimated from the other method.

There are many difficulties involved in knowing what portion of the gallons sold are used in Marysville. Other fuel distributors outside of Marysville make deliveries to retailers in the city. It is likely that the actual number of fuel gallons sold through Marysville, especially because of sales to farmers, is much larger than is estimated by the VMT method.

TABLE 16

Transportation Energy Demand Profile, 1982

Vehicle Type	Percent Vehicles & VMT	Annual Vehicle Miles Traveled	Miles Per Gallon (MPG)	Total Demand Gallons	Percent Total Demand
Auto	64.7%	4,917,458	15.1	325,659	54.9%
Light Truck	28.0	2,128,110	12.0	177,342	29.9
Medium Truck	2.2	167,208	5.9	28,340	4.8
Heavy	2.6	197,910	3.4	58,121	9.8
Motorcycle	2.5	190,010	51.0	3,726	.6
Total	100 %	7.600,395	-	593,188	100 %

Energy Type	Gallons	MBTU	Cost$
Gasoline	520,897	65,149	625,076
Diesel	72,291	9,976	79,520
Total	593,188	75,125	704,596

2.7.5 An Alternative Transportation Energy Demand Estimate

The above estimate of Marysville transportation energy demand for the 1982 base year is used in the final energy assessment tally, but in order to give perpective to the above estimate and to indicate part of the problem in accounting for transportation energy on the local level in a small town, the following alternative calculation is made.

The transportation sector involves the most difficulty conceptually in knowing what transportation energy should be accounted for because of the extensive transportation network that holds the social and economic fabric together. The following calculation is a more reasonable estimate of total transportation energy demand for Marysville. Using state per capita transportation energy demand for passenger vehicles[31] we have the following estimate:

State per capita Energy Demand for Passenger Vehicles	Marysville Population	Alternative Total Marysville Transportation Energy Demand
452 gallons	3670	1,658,840 gallons

This total number of gallons is more than 2.8 times the number of gallons from the previous estimate. Converted to gasoline BTU equivalents this equals 207,481 MBTU's. If this amount is used in the final tally of Marysville energy demand, transportation energy demand would account for 41 percent of the total community energy demand. At 1982 prices ($1.20/gal.) this transportation energy would cost $1,990,608 which would be 53.7 percent of the total energy costs of all the other sectors.

2.8 MARYSVILLE ENERGY DEMAND ASSESSMENT SUMMARY, 1982

This report assesses end use energy demand within each sector as shown in summary Table 17. End use energy is converted to primary energy as shown in Table 18. The following conversion factors were used in converting to primary energy:

	End Use BTU's	Conversion Factor	Primary BTU's
Refined Petroleum Products ...	( )	1.156	( )
Natural Gas	( )	1.075	( )
Electricity	( )	3.4	( )

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[31] Kansas Department of Transportation 1981 Kansas Profile of Transportation Energy Consumption (Topeka, Kansas, June 1983) one page.

TABLE 17

End Use Energy Demand Summary By Sector, 1982

	Electricity	Nat. Gas	Gasoline	TOTAL	Percent
Residential					
MBTU	38,882	178,202	-	217,084	58.5%
Cost $	729,755	513,736	-	$1,243,491	49.9%
Commercial					
MBTU	22,478	35,858	-	58,337	15.7
Cost $	311,086	89,774	-	$400,795	16.1
Municipal					
MBTU	5,012	2,464	(2,303)	7,476	2.0
Cost $	82,435	5,846	(21,389)	$88,281	4.4
Schools					
MBTU	1,925	11,417	(5,282)	13,342	3.6
Cost $	27,287	27,450	(46,744)	$54,737	4.1
Transport.					
MBTU	-	-	75,125	75,125	20.2
Cost $	-	-	704,596	$704,596	25.5
Total					
MBTU	68,297	227,941	75,125	371,363	100 %
Cost $	1,150,563	636,806	704,596	$2,491,965	100 %

TABLE 18

Primary Energy By Sector, 1982

Sector	Electricity MBTU	Natual Gas MBTU	Gasoline MBTU	Total MBTU	Percent %
Residential	132,199	191,567	-	323,410	57.4
Commercial	76,425	38,547	-	114,901	20.4
Municipal	17,041	2,649	-	19,685	3.5
Schools	6,545	12,273	-	18,795	3.3
Transportation	-	-	86,850	86,850	15.4
Total	232,210	245,036	86,850	563,641	100 %

Primary and end use energy by sector is shown in Figure 14. and by energy type in Figure 15. The pie charts represent total primary energy. Each portion of the primary energy pie is given two percentages. The upper figure is the percentage of primary energy and the lower figure is the end use energy percentage if the total pie were end use energy. The white portion of each pie section is the primary energy which is lost due to conversion and distribution processes and the shaded portion is end use energy. The larger the sector electricity demand the larger the energy loses. Overall, 34.1 percent or 192,278 MBTU of primary energy is lost or wasted.

As indicated in the earlier definitions concerning measurment of energy useage, the above 34.1 percent efficiency for Marysville is comparable to the 37 percent for the U.S. system of primary energy.

One of the most comprehensive techniques of showing an energy system is the "spagettei" flow diagram shown in Figure 16.

2.8.1 Energy Costs

Energy demand and cost by sector and by energy type are shown in Figure 17. To explain why the percentage differences in energy demand and cost, energy cost per MBTU for the three energy types is shown below. Therefore the relationship between energy demand and cost between sectors will vary depending of the mix of energy types.

Energy Type	Cost Per MBTU
Natural Gas	$2.88
Gasoline	$9.59
Electricity	$18.76

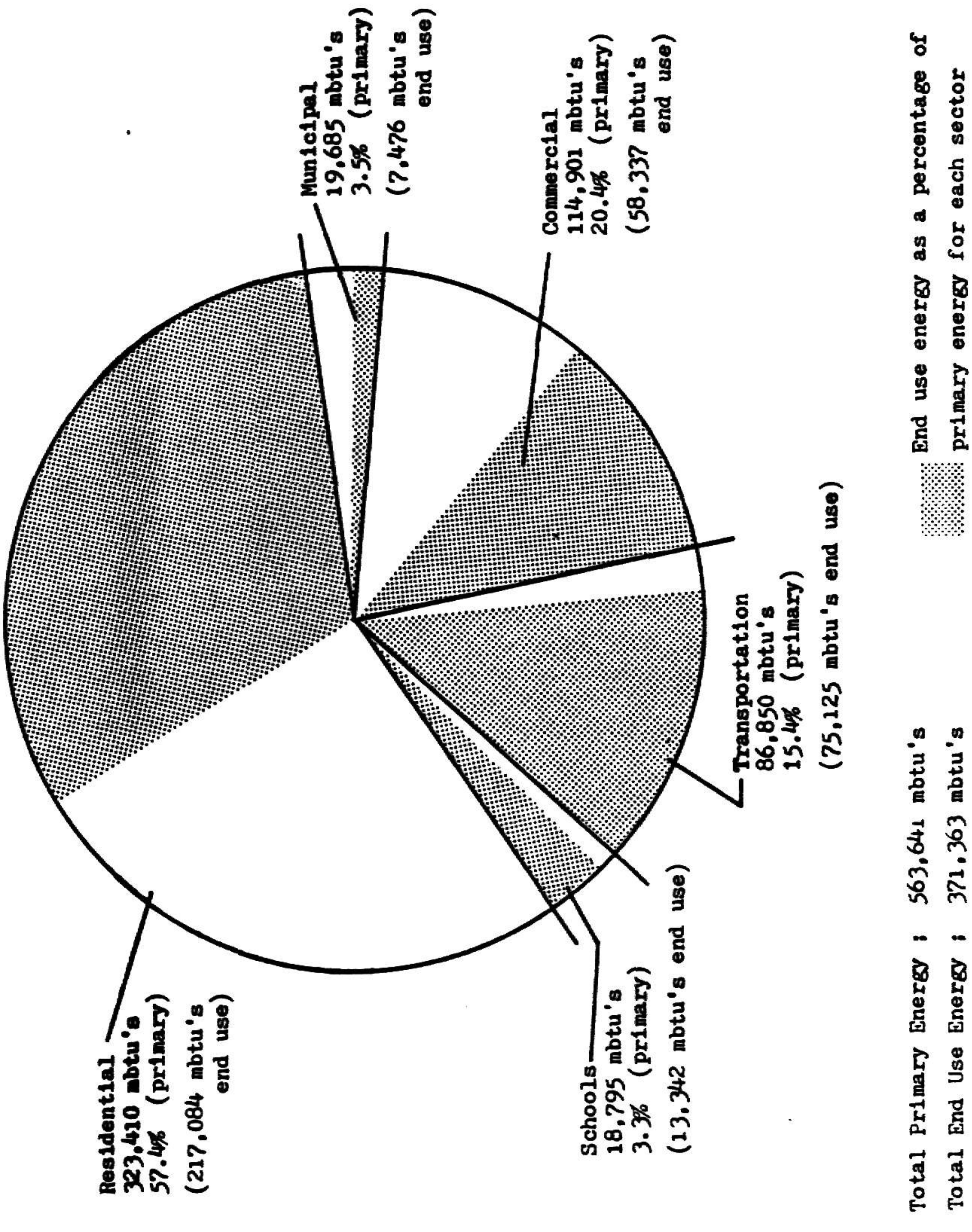

Figure 18: Primary and End Use Energy By Sector, 1982

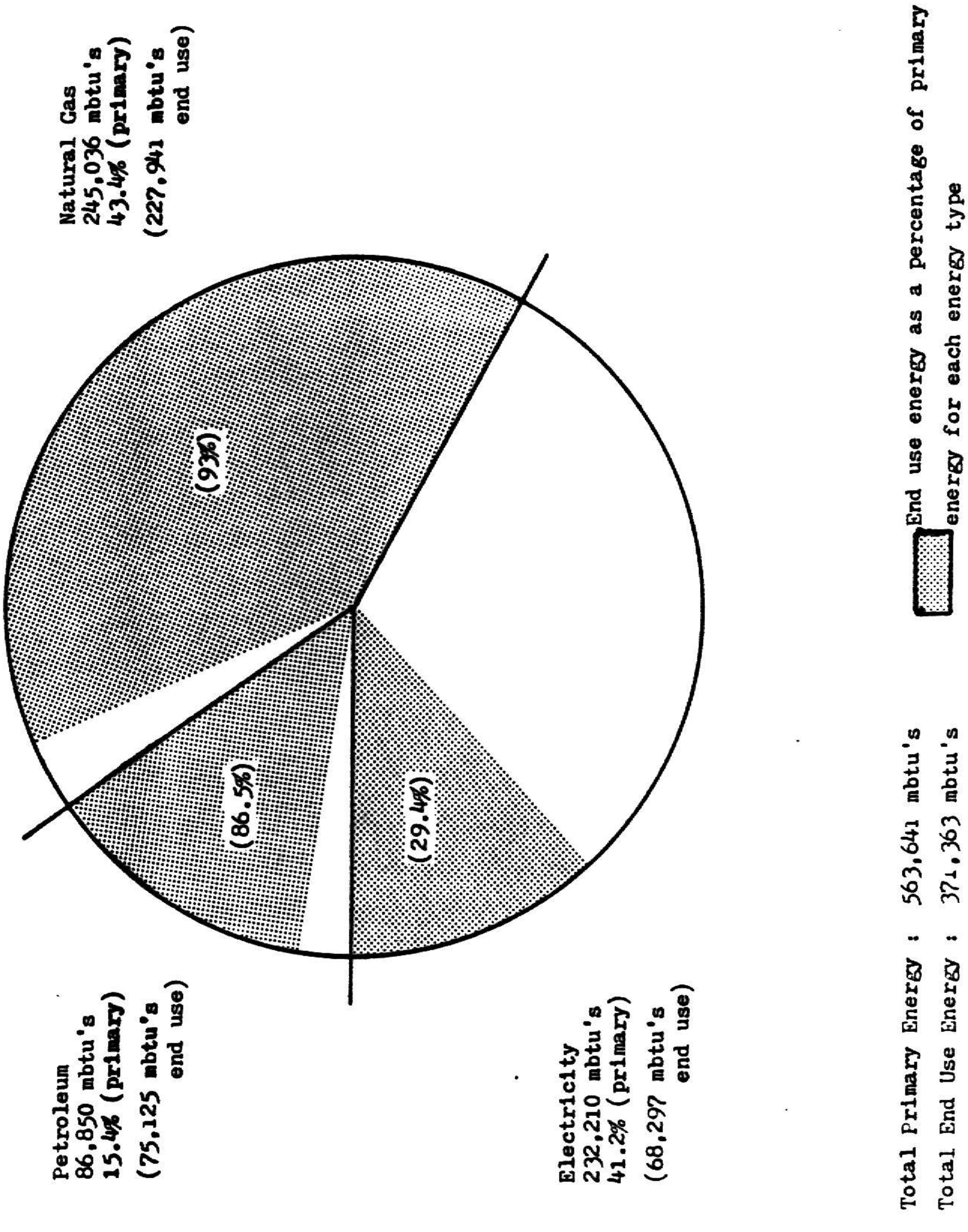

Figure 19: Primary and End Use Energy By Energy Type, 1982

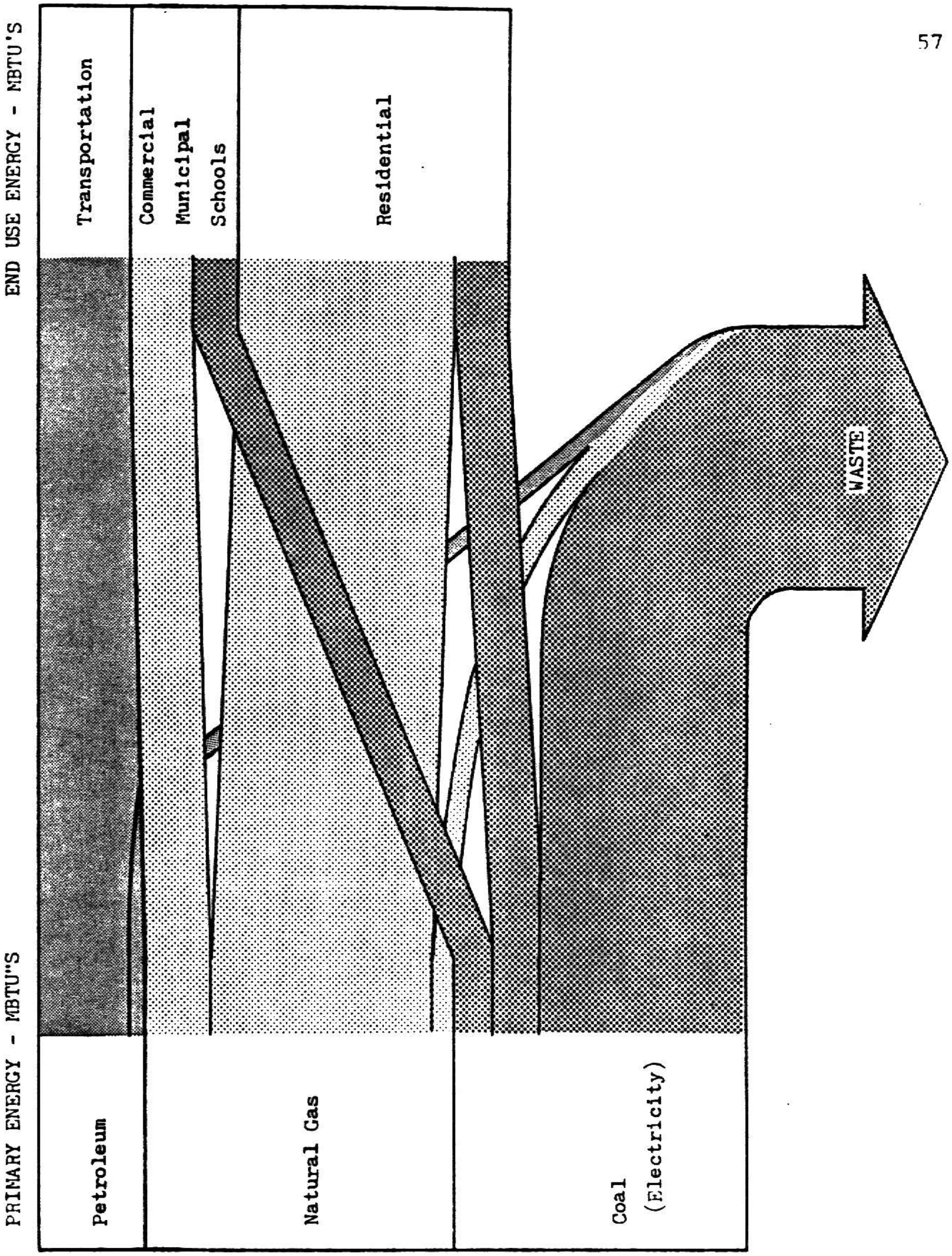

Figure 20: Marysville Conventional Energy Flow Profile, 1982

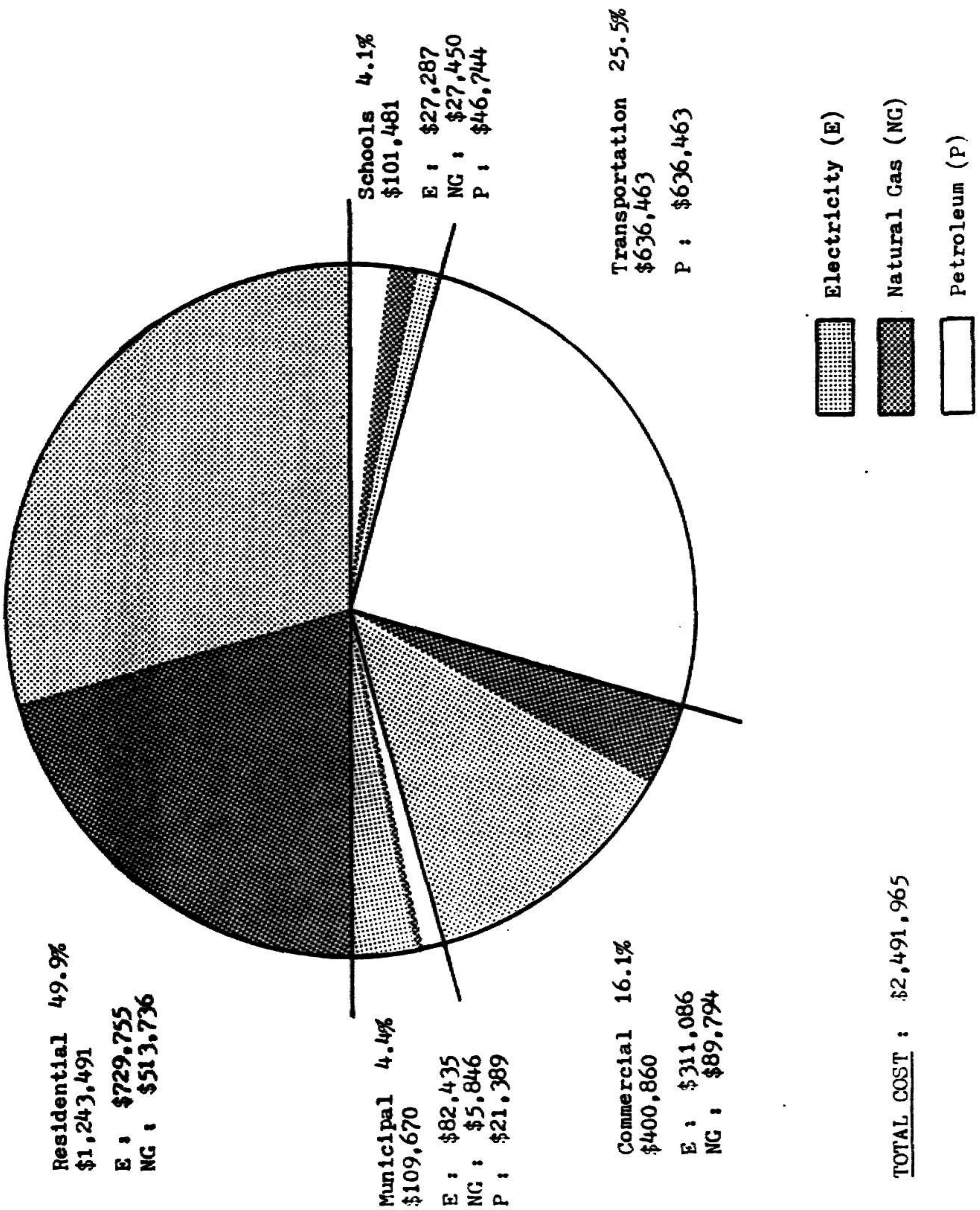

Figure 21: Marysville Energy Cost By Sector and Energy Type, 1982

2.8.1.1 Energy Dollar Drain On The Local Ecnomy

So far the energy study has focused on an overview of the energy consumption and cost patterns in Marysville. The larger pattern of energy and dollar flows have important impacts on communities just as on nations. As a nation we became dependent on cheap energy, from the 1920's to the 1950's we grew to become dependent on cheap energy. In the 1950's our energy demand began to outgrow domestic energy supply and we began importation. Thus becoming dependent on unstable foreign sources for our cheap energy. When the price of imported oil rose we had little choice but to pay, and we have continued to pay, which has greatly contributed to economic recession and record balance of payments deficits. The situation in Marysville can be viewed in much the same way. Electricity is imported from a nationally interconnected grid, pipelines bring in natural gas, and oil products which are all imported to Marysville. Most of the money that is spent for this imported energy leaves the local economy immediately and permanently. Much of the money, though it is hard to say how much, leaves the state in the form of fuel costs and corporate profits. At least 30 percent of the local utility stock is held by out of state owners.[32] The small amount of money that is retained in the local economy is mainly in the form of employee salaries, taxes and profits.

To determine how much money leaves the Marysville economy to pay for energy an estimate of the amount of money retained in the community by energy type is shown in Table 19.

According to this calculation then, Marysville spent $2,491,965 for energy in 1982 with $327,321 or 13 percent remaining in the community and $2,165,644 or 87 percent leaving the community directly. Similar findings for other communities indicate that "most of a communities energy bill represents dollars that are 'exported' from the community to other locations."[33]

A detailed study of the direct community energy costs balanced with income from energy production for Harvey County, Kansas, indicated that of the 59.9 million dollars spent on energy in 1981, between 85.5 and 87 percent or 51 to 52 million dollars left the county in 1982.[34]

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[32] Mari Peterson and Diane Tegtmier, Kansas Energy - A Resource Guide for Community Action Vol. I, p. 42.

[33] Michael J. Meshenberg et al., Guidebook for Establishing a Local Energy Management Program, p. 18.

[34] Mari Peterson, A report on the Energy Income Retained in Harvey County from Conventional Energy Business Activity prepared for the Harvey County Board of County Commissioners (n.p. work sponsored by Energy for Rural Self Reliance, September 1982), p1.

TABLE 19

Marysville Energy Cost Drain Calculation, 1982

		Dollars Retained Locally			
	Total Spent	Taxes	Salaries	Profit	Drain
Electricity	$ 1,150,563	33,493			
Natural Gas	636,806	12,430	232,912		1,508,558
Gasoline	704,596	------	-------	47,510	657,086
Total	$2,491,965	(	$326,321	)	$2,165,644

Note:
Assumptions- 1) local utility franshise taxes at the rates of 2.91% of electricity costs and 1.95% of natural gas costs (see Residential Assessment Methodology for determination of percentages), 2) 16 utility employees that live in the city with average earnings of $14,557 per year (based on conversations with utility officials), 3) average profits of $.074 per gallon for gasoline and $.124 per gallon for diesel (from the Riley County Energy Project Report).

2.8.1.2 Household Energy Costs

Average household energy costs are calculated in three ways:

1. Average Residential Energy Costs- dividing the Residential sector total energy costs by the number of households yields an average residential energy cost of $819.

2. Average Household Energy Cost - average household local transportation energy cost is added to the Average Residential Energy Cost ($402 + $819 =) $1,221.

3. Average Household share of Total Community Energy Cost - The total community energy cost is divided by the number of households. For a small town this method seems justified because most of the energy costs of the other sectors are paid by the household through taxes, higher costs for goods and services and direct energy costs. This method is a more accurate estimate of actual household energy costs. Therefore the average household share of total community energy costs are $1642.

Again it should be noted that even this total household energy cost includes only a portion of the much larger alternative estimate of total transportation energy cost. Average household energy cost for the alternative transportation energy estimate is $1,311, which is alone more than the above Average Household Energy Cost. Using this larger alternative transportation energy cost and the Average Household Energy Cost less the household local transportation energy cost ($1,642 - $402 = $1,240) and then adding the per household share of the alternative transportation energy cost ($1,240 + $1,311 =) $2,551.

The 1982 median household income for Marysville is estimated to be $16,000, which is the same as for Marshall County.[35] Energy costs as a percentage of income are then as follows:

1. Average Residential Energy Costs = 5.1%
2. Average Household Energy Costs = 7.4%
3. Average Household share of Total Community Energy Cost = 10.3%
4. Average Household Share of Total Comunity Energy Cost using the Alternative Transportation Estimate = 16.0%

A recent national survey of consumer expenditures included energy costs which are comparable to the Average Household Energy Costs listed above. From Table 20 it can be seen that the Marysville median income is slightly less than the income level of the middle 20 percent quartile and yet Marysville's average household energy costs, 7.4 percent of income, are considerably less than the national average household energy costs of 10.8 percent of income.

Increasing energy prices have resulted in large income transfers. Imported energy has reduced incomes of Americans overall. "But domestic energy producers also gain if domestic energy prices are allowed to rise. Since about 80 percent of our energy is domestically produced, this transfer between Americans from energy consumer to energy producers is much larger than the transfer to foreigners. On the average, Americans are not poorer because of this - it is from one American to another - but particular Americans will experience large income gains an other Americans will experience large income losses."[36] As Table 20 illustrates, 100 percent increase in the price of energy would reduce the real income of the average American 10.8 percent it would reduce the real income of the poorest quartile of families by 24.6 percent. The real income effects among the poor are almost four times as large as they are

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[35] Marshall County median household income for 1979 of $12,607 is from the 1980 U.S. Census, this amount is increased by the rate of general inflation between 1979 and 1982 using a factor of 1.26, which equals $15,885. Rounding up to $16,000 to account for a real increase in income.

[36] Lester C. Thurow, <u>The Zero-Sum Society</u>, (New York: Penquin Books, 1980), p. 29.

among the rich.

TABLE 20

National Household Energy Costs

Annual energy costs include electricity, natural gas and gasoline.

Gross Income By Quartile	Gross Average Income	Annual Energy Cost	Energy Costs As Percent of Income
Lowest 20%	$3,562	$877	24.6%
20%	9,417	1,408	15.0
Middle 20%	16,190	1,750	10.8
20%	24,253	2,163	8.9
Highest 20%	$42,440	$2,644	6.4%

Source: U.S. Department of Labor, Bureau of Labor Statistics
news release concerning the
1980-1981 Consumer Expenditure Survey
May 23, 1983.

2.8.1.3 Energy Conservation and Local Economic Development

Increasingly municipal government has become more involved in local economic development programs to secure and expand the tax base, increase the quality, quanity and types of jobs in the community and assist in placing local residents in available job opportunities. "Persistant increases in the cost of energy and intermittent limitations in energy supply can effect the economic development efforts of local government. Ignoring this relationship can threaten the economic viability of a community."[37]

The two basic approaches of municipal involvement in local energy management to achieve economic development objectives are, 1) for local government to become involved in directly producing and distributing energy to attain both energy supply and economic development objectives; decentralized energy sources create new jobs and create these jobs adjacent to local economies, 2) local goverment can become involved in energy conservation to reduce energy expenditures in both commercial/ industrial firms and households.

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[37] John Alschuter, "Using Local Energy Programs For Economic Development," Management Information Service Report (International City Management Association, Volume 12, Number 11, November 1980), p. 6.

There are important side effects for the local economy when energy expenditures are reduced and the outflow of energy dollars curbed. A concept in economic theory is that overall spending tends to increase by more than the initial expenditure as dollars circulate through an economy. When income received by direct labor is spent in the local economy it generates local income and employment. Furthermore, direct sales to businesses generates profits which are used to generate additional local sales, income and employment. A portion of these sales is spent on material inputs which can be produced in other local buinesses. These businesses, in turn, can employ local workers whose income is spent on local goods and services. Thus, there is a "ripple"or multiplier effect throughout the local economy. Craig L. Moore, an economist at the University of Massachusetts, has done research based on the economies of over 300 cities. He estimates that a city the size of Marysville generates about $1.34 of local income for every dollar spent and circulated in the local economy.[38] In other words for every dollar in energy costs that can be retained and spent in the local economy, instead of directly leaving, the community's economy could gain a $1.34. Thus, if the money that now leaves the Marysville economy to pay for energy ($2,165,644) could be kept and spent in Marysville, the local economy would gain ($2,165,644 x 1.34 =) $2,901,963 in income annually or $1,911 per household, or as many as 180 jobs per year.

The current energy dollar drain can be reversed by reducing the use and thereby the cost of imported energy. The energy dollar savings can be spent locally which will "ripple" through the local economy generating additional income and if the materials and labor for the conservation measures are purchased locally then that spending will also "ripple".

Another way of visualizing the magnitude and importance of this economic drain can be seen in the fact that in 1982 about 20 percent of the Marysville payroll income is spent on energy, assuming 900 employees with an average annual income of $16,000 (this is probably generous since the income average is based on the estimated 1982 median household income, rather than average income per employee, some household have more than one payroll income earner). If Marysville were located in the electrical service area of Kansas Gas and Electric Company (KG&E) or Kansas City Power and Light Company (KCP&L), where electric rates are expected to double when the Wolf Creek nuclear plant in Burlington, Kansas begins operation in mid-1985, approximately an additional $1,150,000 in increased electrical energy expenditures would leave the community. This amount

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[38] Craig L. Moore, "A New Look at the Minimum Requirements Approach to Regional Economic Analysis," <u>Economic Geography</u>, October 4, 1975, p. 355. City population reported that is closest to the size of Marysville is 2,700 which is 26 percent lower than the 1979 Marysville population (3670). So the actual Marysville multiplier factor could be larger.

is equivalent to at least 72 payroll jobs per year that would, in a sense be lost.

Chapter III

MARYSVILLE ENERGY FUTURE SCENERIO PROJECTIONS

3.1 OVERVIEW

Having developed a profile of the Marysville energy demand system for 1982 the next step involves comparing two future scenerios of energy demand and supply. There are far too many factors and uncertainties involved to make an accurate projection of what will actually happen. The purpose here is to present an image of what could happen under a number of different assumptions about key variables which affect energy use and cost. The importance of these projections is not in any particular number but rather the whole picture or trend that emerges.

3.1.1 Methodology

The methodology for comparing energy future scenerios is divided into two parts as described below.

3.1.1.1 Business as Usual Scenerio

The projection method used for this report is to first project a Business As Usual (B.A.U.) scenerio which assumes little change in the energy demand intensities and energy efficiency levels from the 1982 base year.[39] Rather than representing a realistic expectation of Marysville's actual energy future, the B.A.U. projection is a way of arguing for a serious commitment to Soft Path energy actions.

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[39] U.S. Department of Energy, Energy Information Administration, 1981 Annual Report to Congress Volume 3, Energy projections. February 1982, p.24. The report projects for 1985 that nationally that per captia energy consumption will decrease 6.8% from 280 MBTU in 1979 to 261 MBTU.

3.1.1.2 Soft Path Scenerio

The Soft Path scenerio consists of two basic strategies for reducing nonrenewable energy demand:

1. Strategy One - (reduces energy demand in two ways)
   a) Conservation - reduces energy demand by improving end use energy efficiency (adding insulation, more efficient replacement equipment, etc.),
   b) Solar - energy demand for space heating and water heating are reduced by the use of solar thermal measures (active and passive solar thermal collection).
2. Strategy Two - from the post-Strategy One nonrenewable energy demand base, Strategy Two involves the utilization of renewable energy technologies to supply a portion of the remaining energy demand.

3.2 RESIDENTIAL SOFT PATH STRATEGY ONE SCENERIO

3.2.1 Methodology

The first step is to make a population projection for Marysville which is the basis for all the other sector projections. From the projected population a housing profile is developed from which the B.A.U. and Soft Path projections are based. The B.A.U. energy demand is projected first. For the existing housing units projected to survive and the new construction, Strategy One conservation measures are introduced that reduce energy demand by end use from the B.A.U. baseline in two ways. First energy demand is reduced assuming 100 percent participation in the various measures. A second calculation is made assuming 75 percent participation.

3.2.2 Population and Housing Projection

Two of the basic questions involved in projecting future residential energy demand are, first, how many units of the existing housing stock will survive to the year 2002, and, how many new dwelling units will be constructed between 1982 and 2002? The size of Marysville's future population is a key part in determining answers to these questions. Population projections for Marysville for 1990 range between 3,500 and 4,832.[40] A projection made for use in

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[40] John Keller, James T. McCullough and Ray B. Weisenburger, Marysville Kansas, Areawide General Plan (Manhattan: Prairieland Planning and Development Co.,1977),pp. 4-24.

this report estimates a population of 4,500 in the year 2002.[41]

Based on the projected population increase and assuming the same average number of persons per household of 2.4 persons per household (rounded up from 2.33 for 1979 Census and which is also closer to the 1982 average of 2.47) a net increase of 357 dwelling units is projected for the year 2002.

The first step in calculating a future residential energy demand is to assess what portion of the existing housing can be expected to survive to the year 2002. The largest factor influencing this survival estimate is the Blue River one hundred year floodplain where approximately 25 percent of the current housing is located as shown in Figure 23. This is also where the highest concentration of housing in need of repair is located as shown in Figure 22.

It is assumed for both the B.A.U. and Soft Path scenerios that 20 percent of the total 1982 base year housing stock (302 dwelling units) is relocated out of the floodplain and that the replacement housing is assumed to be single family gas heated (to simplify calculation).

The housing stock profile used for both the B.A.U. and Soft Path scenerio projections is shown in Table 21.

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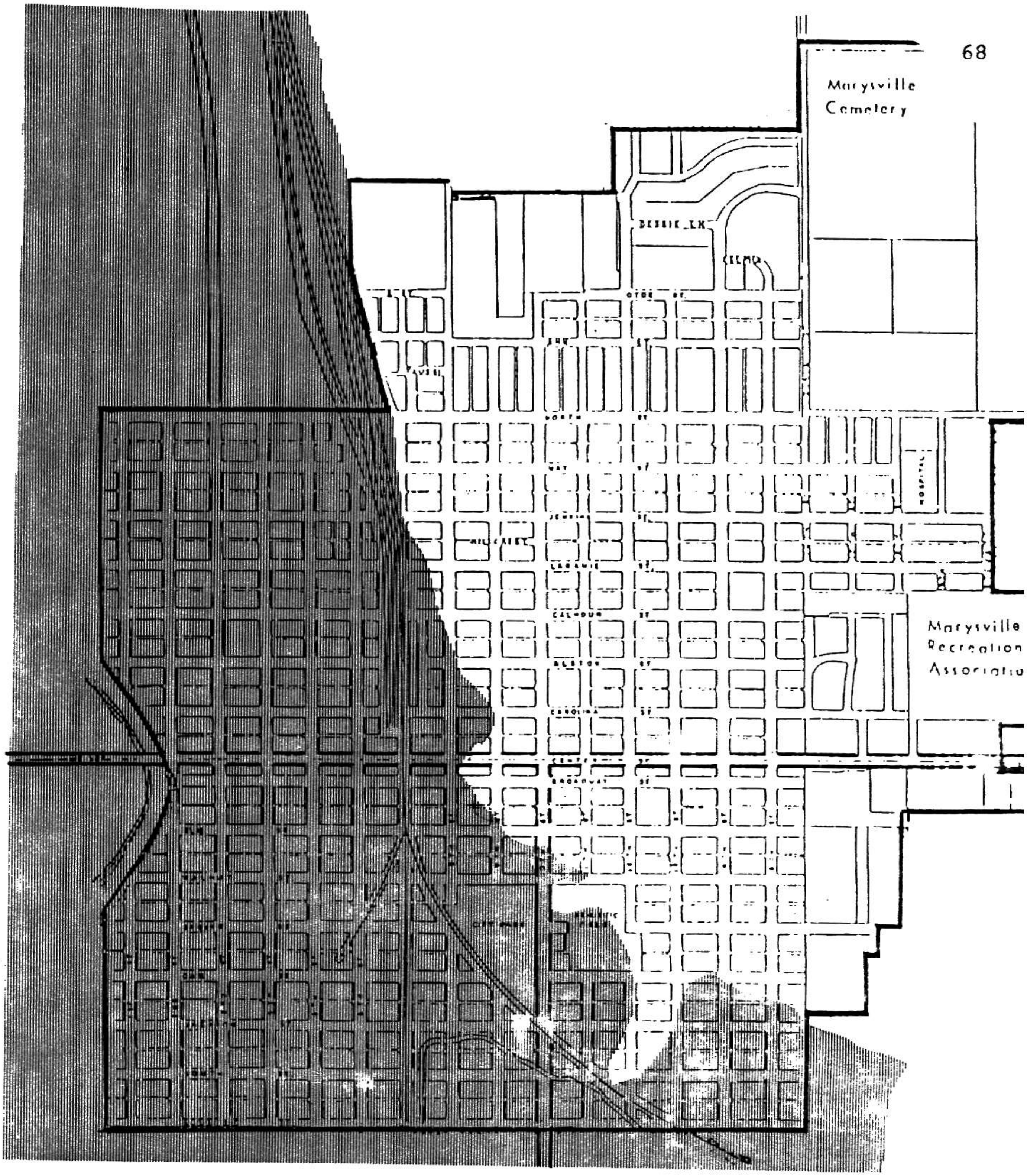
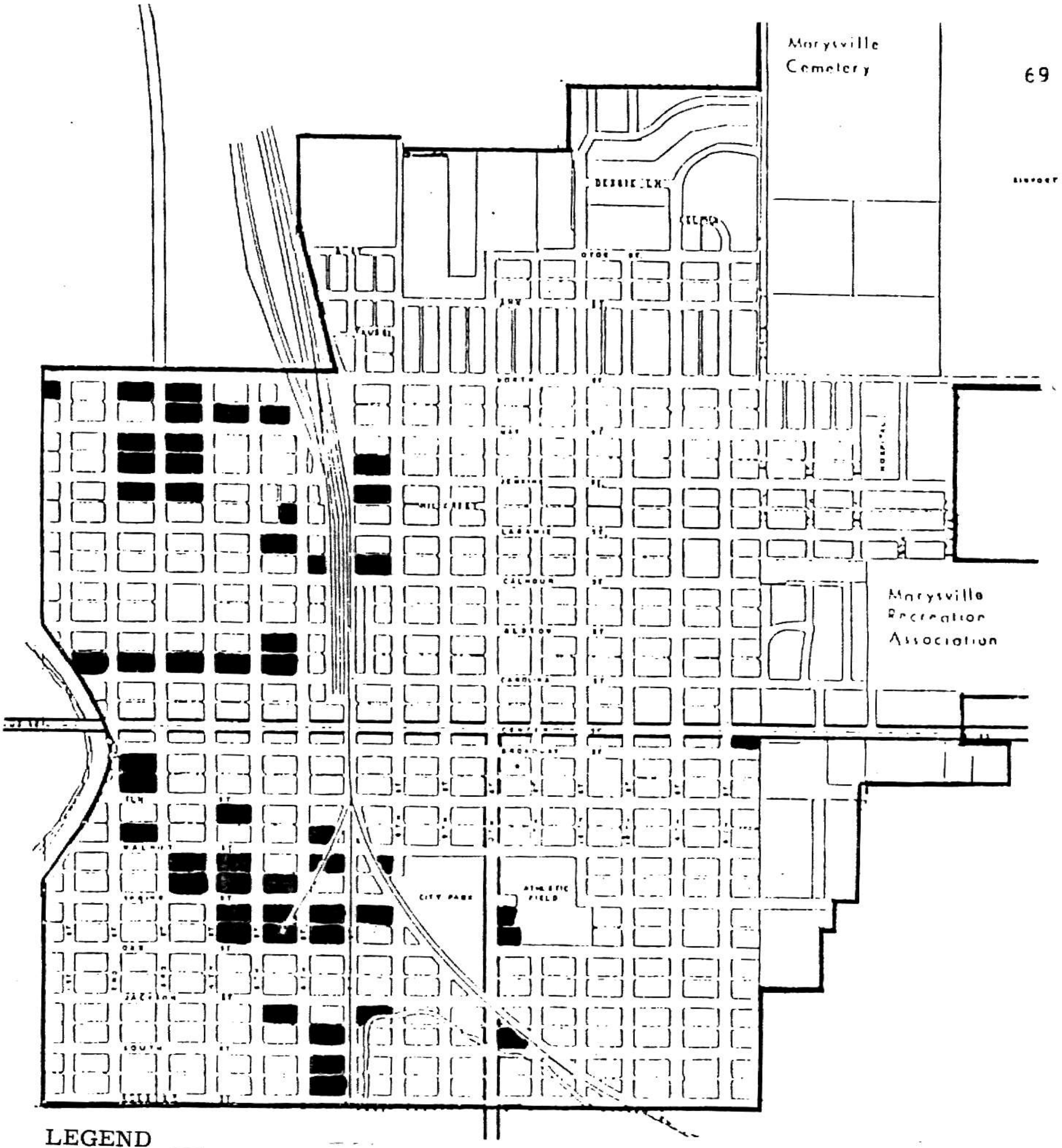
[41] A cohort survival projection model was used for this report. The model the model uses the age/sex structure and birth and death rates to project the population. Based on 1970 and 1980 census data and assuming no migration this method projected a population size of 4,172 in the year 2000. Further assuming that Marysville will remain a desireable place to live and that more people will move to the city than move away, a population size of 4,500 is used as the projected population size for the year 2002. An age/sex pyramid of the projected population is shown in Appendix D.



Source: Kansas Department of Economic Development, <u>Community Inventory Research Phase</u>, <u>Marysville</u>, <u>Kansas</u> (November, 1976), p. 88.

Figure 23: Marysville Kansas River One Hundred Year Floodplain



LEGEND

■ Blocks in which 50% or more of Housing Structures are in need of Major repair

Source: Kansas Department of Economic Development, Community Inventory Research Phase, Marysville, Kansas (November, 1976), p. 68.

Figure 22: Concentration Of Housing In Need Of Repair

TABLE 21

Projected Profile of Houses by Heating Energy Type

	Existing Housing		New Construction	
Dwelling Type	Gas Heated	Elec. Heated	Gas Heated	Total
Single Family	907	73	603	1583
Multi-Family	179	10	40	229
Mobile Homes	47	--	16	63
Total	1133	83	659	1875

3.2.3 Residential Business As Usual Scenerio

The Business As Usual Scenerio (B.A.U.) assumes a continuation of current consumption levels for existing housing projected to survive to the year 2002. Energy Demand averages by dwelling type are the same as for the 1982 base year except for single family units. For single family units average energy demand for new construction is the same as the average for houses built between 1960 and 1982 from the Marysville Energy Survey, which is higher than the average for the sample as a whole. The reason for this assumption is that the Marysville Residential Energy Survey clearly shows the increase in heated square footage and in the total average energy demand. While nationally average residential energy demand has dropped, evidence of that trend was not found in the sample Marysville residenses from the survey. Using these assumptions total energy demand for the Residential B.A.U. Scenerio increases by 26.1 percent and average energy demand per household increases by 5% from 143 MBTU to 150 MBTU. Energy demand for the Business As Usual Scenerio is detailed in Table 32.

3.2.4 Soft Path Strategy One in Existing Residential

End use energy demand for 1982 existing housing projected to survive to the year 2002 is reduced by end use by Strategy One conservation and solar measures as presented below. The maximum reasonable technical potential energy demand reductions are projected. The only limitations considered are estimates of replacement or turnover rates, which are basically a fuction of the age of the existing stock and the income of the households. Later adjustments are made that account for household participation or choice in the use of the measures.

3.2.4.1 Space Heating

The first focus for energy demand reduction is the largest end use, space heating. The basic characteristics of the 'typical' Marysville house, based on the Marysville Residential Energy Survey averages and other sources, is shown in Table 22. This information is used in a heat loss calculation, Table 23. From this calculation it is determined that for the 1982 heating season the actual heating energy needed for this structure is 68 MBTU. The average total energy used was 96.1 MBTU for this 'Typical' house. The difference of 28.1 MBTU is accounted for in furnace and ducting system inefficiencies. In other words it is deduced that the'typical' Marysville has a 70.8 percent efficient heating system.

TABLE 22

Basic Characteristics of the Typical Single Family

Gas-Heated Residence

Total Area	1370 sq. ft.
Window Area	205 ' '
Door	40 ' '
Ceiling	R-18
Wall	R-9
Window Glazings	single pane with storms
Infiltration Rate	one air change per hour
Heating System Efficiency	70.8 percent
Space Heating Annual Fuel Use .	96.1 MBTU

Note:
The average floor area, the average annual space heating fuel use, insulation values and window glazings are taken from the Marysville Residential Energy Survey. The window and door area are based on the assumptions that the 'Typical' house is one and one half stories with two entry/exist doors. The infiltration rate and heating system efficiency are taken from the calculations below. These Basic Characteristics are similar to those used in the SERI report _A New Prosperity_ (_page 51_).

TABLE 23

Heat Loss Calculation For Typical Base Year House

Shell Loss

	Area Sq. Ft.	R Value	U Value	U x Area Btu/Sq. Ft./Hr./F.
Wall	1388	9	.11	153
Roof	914	18	.055	50
Door	40	3	.29	12
Window	205	2	.5	103
Total				318

Infiltration Loss

		Air Changes Per Hour		Volume Cubic Feet		
.018	x	1	x	10,945	=	197

Total Heat Loss

(318 + 197) x 24 hrs. x 5498 HDD = 68 MBTU

Heating System Efficiency

68 MBTU (required) - 96.1 MBTU (actual use) x 100 = 70.8%

Note:
Actually there is some heat loss from the basement or slab, but here the loss is assumed to be negligble. The one air change per hour is probably lower than actual, but is the only factor that can be adjusted in the formula. At the one air change per hour, the heating system efficiency of 70.8% is relatively high compared to the 60% to 68% averages used in the SERI study. If the air change rate increases the MBTU required increases and since the actual MBTU used is fixed the efficiency rate would increase to over 70.8%.

From this description of space heating energy demand, modifications can be introduced to reduce energy demand. Improvements in the 'Typical' house to standards similar to those used in the Residential Energy Use Survey reduce space heating energy demand by 56.1 percent (96.1 MBTU to 42.2 MBTU). The heat loss calculation for these improvements is shown in Table 24.

TABLE 24

Heat Loss Calculation With Conservation In Typcial House

Shell Loss

	Area Sq. Ft.	Conservation Measures	R Value	U Value	U x Area BTU/Sq.Ft./Hr./F.
Wall	1388	Add insulation	13	.077	107
Roof	914	Add insulation	38	.026	24
Door	40	(no change)	3	.29	12
Window	102	R-5 insulating shutters added to half the windows	7	.14	14
	103	(no change)	2	.5	52
Total					209

Infiltration Loss

is reduced by 20 percent by weatherstripping and caulking.

		Air Changes Per Hour				
.018	x	.8	x	5498 HDD	=	79

Total Heat Loss

(209 + 79) x 24 hrs. x 5498 HDD = 38.0 MBTU

Improvements in furnace and ducting system to 90% efficient

38.0 MBTU - .90 = 42.2 MBTU (a 56.1% reduction from the base of 96.1 MBTU)

3.2.4.2 Other End Uses

Technical potential energy demand reductions for the other end uses are estimated based on recent energy studies, primarily The U.S. Solar Energy Research Institute (SERI) Solar/Conservation Study A New Prosperity and Alternative Energy Demand Futures to 2010, by the Committee on Nuclear and Alternative Energy Systems (CONAES), National Research Council. The following sections describe the maximum reasonable technical potential projected energy demand reductions for each end use. (The only restriction considered is an estimate of replacement rates which are a fuction of the age of the existing stock and the income of the households. Later adjustments are made account for participation or choice in utilizing the reduction measures.

Water Heating - after space heating, water heating is the largest single residential energy end use. The components of hot water energy demand are:

1. The standby loss, the heat lost to the surroundings by the tank, and
2. Water use, the amount of energy contained in the hot water used in the showers, clothes washer, dishwasher, etc.

Water heater efficiency improvements including thicker insulation, spark ignition and stack damper, reduce energy demand by 40 percent and low flow water devices, which reduce total hot water usage, reduce energy demand by another 20 percent, for a total reduction of 60 percent.[42] The CONAES mid-range projection (B) used a 25 percent reduction for water heating energy demand.[43] For this report a 50 percent reduction is used for gas and electric water heaters.

Water heaters are assumed to be replaced on the average of every 10 years.[44] and therefore all water heaters could be affected by these reductions since replacements will be made by the year 2002.

Cooking- Improvements to the electric cooking range include better insulation and reduced losses in the area of the door seal. From an average household usage of 780 Kwh/yr the SERI study projects that equipment improvements will reduce average usage to 624 Kwh/yr, a 20 percent reduction. For gas cooking ranges the prime means of improving efficiency is the pilotless ignition, since pilots consume 4 MBTU/yr or 30 to 47 percent of consumption. The gas pilotless range is then assumed to undergo the same insulation and door seal changes as the electric stove. The SERI study estimates the average usage for the 1980 stock to be 9.0 MBTU/year and projects that by the year 2000 new gas ranges will consume an average of 4 MBTU/year, a 55.6 percent reduction.[45]

The disaggragation of cooking energy by fuel type for the Marysville residential assessment was based on applying a single percentage for cooking to the total household energy demand. The disaggregation by energy type was based on the percentage distribution of how many households used electric (81%) or gas

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[42] Solar Energy Research Institute (SERI), A New Prosperity - Building A Sustainable Energy Future (Andover, Massachusets: Brick House, 1981), pp. 65 - 68.

[43] National Research Council, Committe on Nuclear and Alternative Energy Systems, Alternative Energy Demand Futures to 2010 (Washingtion, D.C.: National Academy of Sciences, 1979), p.57.

[44] SERI, A New Prosperity, p. 68.

[45] SERI, A New Prosperity, p. 75-76.

(19%) ranges. Since the cooking energy for the 'Typical' residence is not disaggregated by energy type,a single estimate is made of actual energy usage for a combination of each range type to determine the percentage reduction. Assume the mix of ranges to stay the same for the year 2002, the percentage of the totol for each type of range (from above) is applied to the projected average energy useage by energy type to determine a weighted average:

Electric range 624 Kwh/yr. = 2.1 MBTU/yr. x .81 = 1.70 MBTU/yr.
Natural Gas range 4.0 MBTU/yr. x .19 = .72 MBTU/yr.

Since it is unlikely that all ranges will be replaced by the year 2002 it is assumed that 25 percent of all ranges projected to be in use in the year 2002 will still consume an average of 9.8 MBTU/year and that 75 percent will consume 2.4 MBTU/year. The adjustment is made:

9.8 MBTU/year x .25 = 2.45 MBTU/year
2.4 MBTU/year x .75 = 1.80 MBTU/year

The projected cooking energy demand is (2.45 + 1.80) 4.25 MBTU/year.

Refrigeration - There are two fairly distinct groups, the frost-free and the partially frost-free, and the manual. The following description of the technical potential energy demand reduction for refrigerators is taken from A New Prosperity.

> There are efficiency improvements that only apply to frost-free units, which use more energy on the average, and though they form only 53 percent of the current stock, they form 80 percent of current sales. (The SERI study assumes) this sales ratio will continue, they (frost- free) form 76 percent of the stock in year 2000. To estimate possible improvements in future refrigerators, we first note that some efficient refrigerators already exist. The stock of frost-free units consume 1700 kwh/yr/unit, but Amana currently makes a 18 cubic foot top freezer unit that uses only 1344 kwh/yr. Further, an Amana prototype, also 18 cubic foot top freezer, has been built and tested to use only 785 kwh/yr. The reductions are obtained by improved insulation and defrost systems.[46]

The SERI study uses 1700 kwh/yr/unit as a base for 1980 and 1000 kwh/yr for new units in 1985 and 500 kwh/yr for new units in 1990. Here it is assumed that replacement refrigerators consume 750 kwh/yr/unit or 1.7 MBTU. Since not all Marysville refrigerators will be replaced by the year 2002 it is assumed that 25 percent of the

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[46] Ibid., p. 74.

units currently in use, with average consumption of 5.5 MBTU/yr/unit (from Table 25), will be in use in the year 2002 and 75 percent of the units will be replacements. The projected weighted average energy demand for refrigerators is (1.4 + 1.3) 1.7 MBTU/yr/unit.

5.5 MBTU/yr x .25 = 1.4 MBTU/yr
1.7 MBTU/yr x .75 = 1.3 MBTU/yr

<u>Cooling</u> - energy demand is reduced in two ways:

1. Improvements in cooling equipment,
2. Reductions related to structure shell improvements.

The SERI study reports that inspections made of the data used to construct the proposed federal Building Energy Performance Standards (BEPS) shows a 15 percent reduction in the final heating load, due to shell improvements (adding insulation) resulted in reducing the cooling load by 6 percent.[47] Proportionately then, if we have a 56.5 percent reduction in space heating energy demand then we could expect a 22.5 percent reduction in cooling energy demand, if housing configurations were similar and there is a straight line relationship between the reductions. To be conservative, a 10 percent cooling reduction is assumed to be attibuted to shell improvements.

Cooling energy demand reductions due to improvements in equipment are based on the CONAES study which grouped together central air conditioning and room air conditioners for a 30 percent total reduction. The total energy demand reduction for cooling is (10% + 30%) 40 percent.[48] To adjust for different equipment replacement rates a composite reduction is developed which assumes that the 56 percent of Marysville households that use window air conditioners will utilize the full 40 percent cooling reduction. It is assumed that the 40 percent of households that have central air conditioning (4 percent use neither and are excluded) will have them replaced more slowly, so that half (50%) of the units will be replaced or (.50 x 40% =) 20 percent of all households will utilize the 30 percent equipment reduction or a (.20 x 30%) = 6 percent overall reduction in cooling energy demand. Furthermore it is assumed that all of the households with central air conditioning will utilize the full 10 percent reduction due to shell related improvements (.4 x 10% = 4%). Therefore the central air conditioning households that make up 40 percent of all projected houses account for a total cooling energy demand reduction of (4% + 6% =) 10 percent.

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[47] Ibid., p. 65.

[48] CONAES, <u>Alternative Energy Demand Futures to 2010</u>, p. 57.

In summary, window units account for a 22.4 % reduction and central air units 10 percent, for a total cooling energy demand reduction of 32.4 percent.

Appliances/Other - include miscellaneous electric and gas appliances. The SERI study estimates potential reductions of approximately 37 percent for appliances.[49] The CONAES study estimates a reduction of approximately 16 percent for appliances.[50] For this report a projected appliance energy demand reduction of 30 is used.

Lighting - the following is from the SERI study:

> "To calculate the savings from lighting improvements (SERI) modelled the fixtures in the 1350 square foot home and calculated which fixtures could be replaced by new improved units. Electric consumption was 100 kwh/yr, with twenty-five light bulbs; consumption increases directly with floor area. The fixtures were two (2) three-way bulbs, three (3) fluorescent tubes, and twenty (20) other incandescent bulbs. Replacement bulbs are either Halarc, or other types of high-efficiency bulbs, or three-way fluorescents. Both three-way bulbs are replaced, as are the twelve incandescents which are used four hundred hours or more per year. The replacement bulbs are assumed to have a lifetime of ten years, though twelve years is expected at the usage rates assumed."[51]

The SERI study assumes a technical reduction potential of 55.7 percent for lighting. For this report a 45 percent reduction is assumed since it is unlikely that all replacements could be made by the year 2002.

Clothes Dryers - the SERI study assumes a 27 percent reduction for gas dryers and a 24.5 percent reduction for electric dryers.[52] From the Marysville Residential Energy Survey, 11 percent of the households use gas dryers, 61 percent electric dryers and 28 percent dry clothes outside. The composite reduction is (.11 x 27% = 3)+(.61 x 24.5%= 15) 18 percent. The full reduction is assumed since most units will be replaced by the year 2002.

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[49] SERI, A New Prosperity, p. 69.

[50] CONAES, Alternative Energy Demand Futures to 2010, p. 57.

[51] SERI, A New Prosperity, p. 77.

[52] Ibid., p. 75

TABLE 25

Conservation in Existing Typical Single Family Residence

End Use	1982 Base Year MBTU	Soft Path: Strategy One Conservation Measures	Red. %	Year 2002 MBTU
Space Heating	96.1	Walls to R-13; Ceiling to R-38; Windows: half remain with storms at R-2, half with R-5 insulating shades added; Added weather-stripping and caulking reduce air change to .8 per hour; Heating system efficiency increases to 90%.	56.1	42.2
Water Heating	30.7	Gas heaters - reduce standby losses with more tank insulation, pilotless ignition; elec. heaters-more insulation. Low flow devices.	50.0	15.3
Cooking	9.8	All ranges - door seal, insulation; pilotless ignition for gas range.	56.6	4.3
Refrig.	5.5	More efficient replacement unit.	52.7	2.6
Cooling	4.2	Due to shell improvements and more efficent replacement equipment.	32.5	2.8
Appli./Other	4.1	More efficient replacement units.	30.0	2.9
Lights	3.7	Replacement of bulbs and Fixtures.	45.0	2.0
Clothes Dry.	1.8	More efficient replacement units.	18.0	1.5
Total	156.0		53.3	72.8

Similar end use energy demand reductions are made for existing electrically heated homes. The three electrically heated homes from the Marysville Residential Energy Use Survey had heat pumps. Since heat pumps are the most efficent method of electrical heating, space heating energy demand reduction measures include only adding insulation and other weatherization measures which reduce space heating energy demand by 15 percent. Other measures, primarily more energy efficient replacement equipment and appliances, reduce total end use energy demand by 33.8 percent from 89.7 MBTU to 59.4 MBTU.

3.2.5 Soft Path Strategy One - New Residential Construction

New residential construction is assumed to be designed and built using passive solar techniques, energy efficient appliances and equipment that reduce energy demand by 88.7 percent from the B.A.U. Scenerio energy demand for new residential construction as shown in Table 26. The B.A.U. energy demand for new construction Table 26 is the average from the Marysville Residential Survey for homes built between 1960 and 1980. The annual space heating energy demand of 12 MBTU is equivalent to an energy intensity target of 1.6 BTU/sq. ft./HDD for the 'typical' Marysville size house of 1370 square feet. This target corresponds to the mid range (between medium and low infiltration) of the proposed federal Building Energy Performance Standard.[53]

For new construction it is assumed that it is more likely that the appliances and equipment will be new and therefore the potential energy demand reductions would be fully utilized rather than including an adjustment for turnover/replacement rates as was done for existing residential housing.

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[53] Ibid., p. 24.

TABLE 26

Conservation In New Single Family Residential Construction

End Use	B.A.U. Base MBTU	Soft Path: Strategy One - Conservation Measures	Red. %	Year 2002 MBTU
Space Heating	106	Passive solar techniques used that reduce fuel input; reduction here based on proposed Federal 'Building Energy Performance Standards'.	88.7	12
Water Heating	34	More efficient water heaters; low flow devices and more efficient appliances reduce useage; solar hot water devices supply 80% of the remaining energy demand.	90	3.4
Cooking	10.9		78	2.4
Refrig.	6.1		72.1	1.7
Cooling	4.7	1.5 window units per house	46.8	2.5
Appli.	4.5		30	3.1
Lights	4.2		45	2.3
Clothes Dryer	2.3		18	1.9
TOTAL	173.0		83.1	29.3

3.2.6 Residential Soft Path Strategy One - Summary

It is now necessary to translate these Soft Path Strategy One - conservation energy demand reductions into a description of the impact on the entire community. Housing from the 1982 base year that is projected to survive to the year 2002 is divided into gas and electrically heated categories as shown in Table 27. Energy demand for the B.A.U. Scenerio is shown along with the Soft Path post-Strategy One conservation energy demand and the percentage reduction from the B.A.U level for each end use. The total energy demand reduction due to the Soft Path conservation measures is 64.3 percent. It may be possible with a concerted community- wide effort, but it is unlikely that this total reduction would be realized by the year 2002, due to economic constraints and personal choice. An alternative reduction would be to take into account a participation factor, say, for example 75 percent of the households in existing and new residences would participate in the reductions outlined. In other words, rather than 100 percent, 75 percent of the households will achieve the energy demand reduction. Therefore if a 75 percent participation rate is taken into account the total reduction would be 48.3 percent from the B.A.U. level as shown in Table 28. For the Year 2002, with 75 percent household participation, the Soft Path Strategy One - conservation measures reduce average energy demand per household from the 1982 level by 44.5 percent from 143 to 79.3 MBTU.

TABLE 27

Residential Soft Path Strategy One - Conservation

Assumes 100 % Community Participation

	Existing Housing						New Construction		
	Gas Space Heat			Elec. Space Heat			Gas Space Heat		
End Use	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU
Heat.									
Space	103,907	56.1	45,615	2,893	15.7	2,459	68,599	88.7	7,752
Water	33,116	50.0	16,558	1,247	50.0	624	21,862	90.0	2,186
Cook.									
N.G.	2,128	56.6	924				1,405	78.0	309
Elec.	8,516	56.6	3,696	944	56.6	410	5,621	78.0	1,237
Refrig.	5,934	52.7	2,807	524	52.7	248	3,904	72.1	1,089
Cool.	4,501	32.5	3,038	330	32.5	223	3,012	46.8	1,608
Applia.	4,392	30.0	2,635	386	30.0	232	2,900	30.0	2,030
light.	4,054	45.0	2,230	358	45.0	197	2,676	55.7	1,185
Clo. Dry									
N.G.	402	18.0	330				264	18.0	216
Ele.	1,606	18.0	1,317	206	18.0	169	1,298	18.0	1,064
Total	168,617	53.1	79,150	6,888	33.8	4,562	111,541	84.1	17,720

100 Percent Participation Strategy One-Conservation Energy Demand By Energy Type

	B.A.U MBTU	Red. %	Stratgy One-Conservation MBTU
Natural Gas	231,683	68.1	73,890
Electricity	55,362	48.5	28,539
Total	287,045	64.3	102,429

Note: S.O.C. = Strategy One - Conservation; E.D = Energy Demand.
Red. = Reduction

TABLE 28

Residential Soft Path Strategy One - Conservation

Assumes 75 % Household Participation

	Existing Housing						New Construction		
	Gas Space Heat			Elec. Space Heat			Gas Space Heat		
End Use	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU	B.A.U. MBTU	Red. %	S.O.C. E.D. MBTU
Heat.									
Space	103,907	42.1	60,162	2,893	11.5	2,502	68,599	66.5	22,981
Water	33,116	37.5	20,697	1,247	37.5	779	21,862	67.5	7,105
Cook.									
N.G.	2,128	42.5	1,224				1,405	58.5	583
Elec.	8,516	42.5	4,897	944	42.5	543	5,621	58.5	2,237
Refrig.	5,934	39.5	3,590	524	39.5	317	3,904	54.1	1,792
Cool.	4,501	24.4	3,403	330	24.4	249	3,012	35.1	1,955
Applia.	4,392	22.5	3,404	386	22.5	299	2,900	22.5	2,248
light.	4,054	33.8	2,684	358	33.8	237	2,676	41.8	1,557
Clo. Dry									
N.G.	402	13.5	348				264	13.5	228
Ele.	1,606	13.5	1,389	206	13.5	175	1,298	13.5	1,123
Total	168,617	39.6	101,798	6,888	25.9	5,102	111,541	62.4	41,809

75 Percent Participation Strategy One-Conservation Energy Demand By Energy Type

	B.A.U MBTU	Red. %	Stratgy One-Conservation MBTU
Natural Gas	231,683	51.1	113,328
Electricity	55,362	36.2	35,381
Total	287,045	48.3	148,709

3.2.7 Soft Path Strategy One Conservation/Solar Scenerio

The next step in energy demand reduction is to incorporate space heating and water heating solar thermal measures for the existing housing projected to survive. The utilization of solar applications is based on the solar suitability assessment part of the Marysville Residential Survey (Appendix B). Combined with the Post-100% participation Strategy One Conservation energy demand the household participation in the solar measures is assumed to 100% for each of the three (high, medium and low) solar suitability category percentages, later an alternative participation is considered.

3.2.7.1 Space Heating

Three solar applications are considered. The first two are passive and active solar systems. The third, super-insulation, while not normally considered a solar application, is included. From the solar suitability assessment 64 percent of the existing residences are in the the 'high' suitability category for solar applications. Primarily because of the various levels of household income and the initial costs involved, it is assumed that one third of the 64 percent or 21.3 percent of the total will utilize combined active space heating and water heating solar systems, another third of the 64 percent will utilize passive space heating and active water heating systems and the last third will utilize passive space heating only.

The assumptions for the active space and water heating solar systems are: 216 square foot solar collector provides 36.2 Mbtu/year or 63 percent of the post - conservation space heating and water heating energy demand.[54] The assumptions for passive solar space heating and active solar water heating are: a combination of passive retrofit features such as vertical heaters or solar greenhouses contribute 12.7 MBTU/year or meet 30 percent of the space heating energy demand.[55] The active solar hot water system is assumed to be a 40 square foot collector providing 10 MBTU/year or 65.4 percent of the hot water energy demand.[56] The assumption for the households that use only passive solar space heating systems are the same as for the passive portion of the above combination (30%).

For the 23 percent of residences with medium solar suitability, a combination of active and passive solar heating measures are utilized that reduce space heating energy demand by 35.0 percent (75%

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[54] Ibid., p. 92.

[55] Ibid., p. 89.

[56] Ibid., p. 95.

of the average active/passive reduction, 63% + 30% - 2 = 46.5 x .75 = 35.0). Solar hot water systems for the medium solar suitability residences are assumed to reduce hot water energy demand by 49 percent (75% of the high access reduction, .75 x 65.4% = 49%).

Superinsulation is assumed to be the High Solar option most appropriate for the 13 percent of the homes with low solar access. The superinsulation measures described in Table 29, reduce space heating energy demand by a total of 76.8 percent from the Business as Usual base or 20.5 percent from the High Conservation base.

TABLE 29

Super-Insulation Heat Loss Calculation

Shell Losses

	Area Sq. Ft.	Conservation Measures	R Value	U Value	BTU/ Sq. Ft./ Hr./F.
Wall	1388	added insulation	33	.03	42
Roof	914	added insulation	77	.013	12
Door	40		33	.29	12
Window	205	insulating shutters to all windows	7.1	.14	29
Total					95

Infiltration Loss

		Air Change Per Hour				
.018	x	.6	x	5498 HDD	=	59

Total Heat Loss

(95 + 59) x 24 hrs. x 5498 HDD = 20.3 MBTU

Improvements in the furnace and ducting increase heating system efficiency to 90 percent

20.3 - .90 = 22.3 MBTU Final Space Heating Energy Demand

TABLE 30

Existing Residential Strategy One Cons./Solar Scenerio

Using the Post-100% Participation Strategy One - Conservation Energy Demand and Assuming 100% participation in solar retrofit measures

	Part. %	Red. from BAU %	Space Heating Nat.Gas MBTU	Space Heating Elec. MBTU	WaterHeating Nat.Gas MBTU	WaterHeating Elec. MBTU
100% Part. Post-Conservation Energy Demand			45,615	2,459	16,558	624
High Solar Access/	21.3					
Active Sp. Heat..............		63				
Active Water Heat............		63				
High Solar Access/.......	21.3					
Passive Sp. Heat.............		30				
Active Water Heat		63				
High Solar Access	21.3					
Passive Sp. Heat.............		30				
Medium Solar Access	23.0					
Passive/Active Sp. Heat		37.2				
Active Water Heating		49				
Low Solar Access/ Superinsulation	13.1	20.5				
Total For Space Heating	100	37.5	28,509	1,537		
Total For Water Heating	100	38.1			10,249	386

Note: Part. = Participation

3.2.7.2 Household Participation In Solar Retrofit Measures

A second Strategy One Conservation/Solar projection for existing residences using the post-75 percent participation Conservation energy demand and assuming 75 percent participation in the solar retrofit measures as shown in Table 35.

TABLE 35

Existing Residential Strategy One - Cons./ Solar Scenerio

Using post-75% participation Conservation energy demand and assuming 75% Participation in Solar Measures

			Space Heating		Water Heating	
	Part. %	Red. %	Nat.Gas MBTU	Elec. MBTU	Nat.Gas MBTU	Elec. MBTU
Post-75% Part. Cons. Energy Demand Base			60,162	2,502	20,697	779
Total For Space Heating	75	28.1	43,256	1,799		
Total For Water Heating	75	28.6			14,881	714

3.2.8 Soft Path Strategy One - Cons./Solar Scenerio Summary

A summary of the Residential Conservation/Solar projection assuming 100 percent participation in the conservation and solar measures shown in Table 32 for an overall reduction of 72.1 percent. A summary of the Residential Conservation/Solar projection assuming 75 percent participation for both sets of measures is shown in Table 33 for an overall reduction of 56.4 percent. The 75 percent participation projection is used in the final sector tally of energy demand.

The 75 percent participation Strategy One Conservation/Solar scenerio reduces average per household total residential energy demand by 54.7 percent from the 1982 base year and 56.6 percent from the B.A.U projected energy demand level as shown in Table 34.

TABLE 32

Residential 100% Participation Soft Path Strategy One Summary

	Business As Usual:		Soft Path: Strategy One Conservation				Soft Path	Total Reduction
	Exist. & New		Existing		New Const.		Total	from
End Use	N.Gas MBTU	Elec. MBTU	N.Gas MBTU	Elec MBTU	N.Gas MBTU	Elec. MBTU	MBTU	B.A.U. %
Heating								
Space	172,506	2,893	28,509	1,537	7,752		37,798	78.5
Water	54,978	1,247	12,402	385	2,168	-	14,955	73.4
Cooking	3,533	15,081	924	4,106	309	1,237	6,576	64.7
Refrig.		10,362	-	3,055		1,089	4,144	60.0
Cooling		7,903	-	3,302		1,602	4,904	37.9
Appl.		7,678	-	2,867		2,030	4,897	36.2
Lights		7,088	-	2,427		1,185	3,612	49.0
Cls. Dry	666	3,110	330	1,486	216	1,064	3,096	18.0
Totals	231,683	55,362	42,165	19,165	10,445	8,207	79,982	72.1

100% Participation Soft Path Strategy One Cons./Solar Energy Demand By Energy Type

	B.A.U. MBTU	Red. %	Soft Path Strategy One MBTU
Natural Gas	231,683	77.3	52,610
Electricity	55,362	50.6	27,372
Total	287,045	72.1	79,982

TABLE 33

Residential 75% Participation Soft Path Strategy One Summary

	Existing		New Construction		Total	Red. From
	N.Gas	Elec.	N.Gas	Elec.		B.A.U.
End Use	MBTU	MBTU	MBTU	MBTU	MBTU	%
Heating						
Space	43,256	1,799	22,981		68,036	61.2
Water	14,881	714	7,105		22,700	59.6
Cooking	1,224	5,440	583	2,237	9,484	49.1
Refrig.		3,907		1,792	5,699	45.0
Cooling		3,652		1,955	5,607	29.1
Applian.		3,703		2,248	5,951	22.5
Lights		2,921		1,557	4,478	36.8
Clo. Dry	348	1,564	228	1,123	3,263	13.6
Total	59,709	23,700	30,897	11,008	125,218	56.4%

75% Participation Soft Path Strategy One Cons./Solar Energy Demand By Energy Type

	B.A.U.	Red.	Soft Path Strategy One 75% Part.
	MBTU	%	MBTU
Natural Gas	231,683	60.9	90,606
Electricity	55,362	37.5	34,708
Total	287,045	56.4	125,314

TABLE 34

Change In Average Per Household Residential Energy Demand

				Soft Path Strategy One 75%Part.		
	1982 Base E.D./H.H.	Change	B.A.U. E.D./H.H.	Change from 1982	Change from B.A.U.	E.D./H.H.
	MBTU	%	MBTU	%	%	MBTU
Heating						
Space	89.5	+4.5	93.5	-59.4	-61.2	36.3
Water	28.7	+4.2	29.9	-57.8	-59.5	12.1
Cooking	9.6	+3.1	9.9	-46.9	-48.5	5.1
Refrig.	5.3	+3.7	5.5	-43.4	-45.5	3.0
Cooling	4.1	+2.4	4.2	-26.8	-28.6	3.0
Appli.	4.0	+2.5	4.1	-20.0	-21.9	3.2
Lighting	3.7	+2.7	3.8	-35.1	-35.1	2.4
Clo. Dry	2.1	0	2.1	-23.8	-23.8	1.6
Total	146.9	+4.2	153.1	-54.7	-56.6	66.5

3.3 COMMERCIAL SOFT PATH: STRATEGY ONE SCENARIO

3.3.1 Methodology

In projecting energy demand for the commercial sector it is necessary to determine: 1) what portion of the existing building stock will exist in the year 2002, and 2) how much new commercial building space will be added between 1982 and 2002. A turnover rate for existing commercial buildings space is estimated based on the historical rate and the construction of new commercial building space is estimated based on the expected increase in new jobs. Strategy One conservation and solar measures reduce energy demand from the B.A.U. energy demand level. The assumed participation rates determine the percentage of businesses, or, actually the percentage of the total end use energy demand that will be affected by the reduction measure.

3.3.2 Existing Commercial Turnover and New Commercial Growth

Based on a review of what has happened in Marysville, about 10 percent of the commercial buildings have been removed or changed use in the past 20 years.[57] This would be an annual rate of .5 percent. Nationally, commercial building space is estimated to decay at an annual rate of 1.5 percent.[58] It is assumed that Marysville will experience a .75 percent annual rate of turnover (decay), or, in 20 years, 15 percent of the 1982 Base Commercial building stock will be removed or changed in use. This is half the estimated national rate, which is assumed reasonable for Marysville, since there is less intense economic pressure on land uses to remove old buildings. The rate is slightly higher than what might be expected based on the historical rate. This accounts for relocation of commercial uses from the floodplain. In summary, 85 percent of the 1982 base year commercial building stock is projected to be in use in the year 2002. The 15 percent balance is assumed to be replaced by new commercial building space.

It is difficult to determine what net growth will occur in commercial building space. One indication is the growth rate in new jobs. From a Kansas Department of Economic Development report, Marysville gained 63 new industrial jobs (the manufacturing commercial sub-category) from a combination of new firms and expansion of existing firms between 1967 and 1978. This is an increase of about 7.5 percent of current total employment (see Chapter I). Although this growth factor is not directly comparable with total commercial building space it is used here as the growth rate in commercial building space. Therefore, it is assumed that total commercial building space will have a net increase of 15 percent for the year 2002 over the 1982 base year. This rate is below the projected population growth of 22 percent, but it can be assumed that the additional population or employees will be absorbed in the existing businesses, involved in farming or commuting to other employment centers.

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[57] Leah Caldwell-Ernst, Historical Development of Marysville (list of commercial buildings and when they were built - based on County tax records; unpublished material gathered summer of 1982).

[58] SERI, New Prosperity, p. 142.

3.3.3 Commercial Business-As-Usual Scenerio

The B.A.U. scenerio assumes the same commercial building space turnover and growth changes as described above:

1. 85 percent of the energy demand will be in buildings built before 1982,
2. 15 percent of the energy demand will be in replacement buildings,
3. there will be a 15 percent increase in total energy demand over the 1982 base year total energy demand, which will be in new buildings.

Energy demand intensities (BTU's per employee) are assumed to remain the same. Commercial energy demand is projected by end use and shown in Table 36.

3.3.4 Soft Path Strategy One In Existing Commercial Buildings

The 1982 base year building stock and new buildings are treated separately. For the portion of the 1982 building stock that is projected to survive to the year 2002, it is assumed that conservation measures are applied that result in a 18.5 percent reduction in end use energy demand.[59] For example, measures such as weatherstripping, added insulation and lower thermostat settings are assumed to reduce total space heating energy demand by 50 percent as shown in Table 36. Also shown in Table 36 are participation rates. For space heating conservation measures it is also assumed that 75 percent of the businesses participate or utilize the measures, such that 75 percent of the space heating energy demand is affected by the conservation reduction. The participation rates for space heating and lighting are higher than for the other end uses because the largest number of businesses have these end uses.

Strategy One solar measures are introduced that reduce the post-conservation energy demand. For example as shown in Table 36, the 40 percent participation rate for solar space heating assumes that 40 percent of the post-conservation energy demand will be effected by the solar measures that reduce energy demand by 60 percent. The combination of conservation and solar measures reduce existing commercial space heating energy demand from the B.A.U. level by 52.5

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[59] SERI, A New Prosperity p. 141. Estimates that existing commercial buildings could potentially reduce energy demand by 50 percent by the year 2000. SERI also reports that surveys indicate that 90 percent of the conservation investments were less than 50¢ per square foot and achieved estimated energy savings in the range of 20 to 35 percent of total energy use (SERI, p. 155).

percent. Strategy One measures for other end uses are difficult to estimate since the research for this report did not include detailed assessments. Overall Strategy One conservation/solar measures reduce energy demand for existing commercial buildings by 31.8 percent. This compares with the 39 percent reduction for nonresidential buildings in the CONAES report.[60]

TABLE 36

Existing Commercial Buildings Soft Path Strategy One

	B.A.U.	Strategy One					Total	
		Conservation			Solar			
End Use	MBTU	Red. %	Par. %	MBTU	Red. %	Par. %	MBTU	Red. %
Heating								
Space	20,049	50	75	12,531	60	40	9,524	52.5
Water	3,460	10	50	3,287	75	80	1,315	62.0
Cooling	1,257	40	50	1,006	40	30	885	29.6
Lighting	7,607	30	75	5,895	-	-	5,895	22.5
Cooking	1,700	10	50	1,615	-	-	1,615	5.0
Refrig.	2,842	20	50	2,558	-	-	2,558	10.0
Ind. Pro.	12,671	5	50	12,354	10	25	12,045	5.0
Total	49,587	(18.5)		40,387	(15.6)		33,837	31.8

3.3.5 Soft Path Strategy One In New Commercial Buildings

For commercial building built after the 1982 base year conservation/ solar measures are assumed as described in table 37. Combined conservation and solar measured reduce energy demand in new commercial buildings by 48.1 percent.[61]

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[60] CONAES, Alternative Energy Demand Futures to 2010 p. 58.

[61] SERI, A New Prosperity, p. 141. Quoting from the report; "analysis of typical office buildings indicate a technical potential of some 60 - 65 percent energy savings from recent design practice using existing technology ..."

TABLE 37

Soft Path Strategy One New Commercial Buildings

	B.A.U.	Strategy One Conservation/Solar		
		Red.	Par.	E.D.
End Use	MBTU	%	%	MBTU
Heating				
Space	7,076	70	100	2,123
Water	1,221	80	100	244
Cooling	445	60	100	178
Lighting	2,685	30	100	1,879
Cooking	600	20	100	480
Refrig.	1,003	40	100	602
Ind. Pro.	4,472	20	100	3,577
Total	17,502	48.1		9,083

TABLE 38

Soft Path Strategy One Commercial Summary

	1982	Business As Usual			Soft Path Strategy One High Cons./ High Solar			Total Red.
End Use	Base Year MBTU	Exist Bldg. MBTU	New Bldg. MBTU	Tot. MBTU	Exist Bldg. MBTU	New Bldg. MBTU	Total MBTU	From BAU %
Heat.								
Space	23,587	20,049	7,076	20,125	9,524	2,123	11,647	57
Water	4,071	3,460	1,221	4,682	1,315	244	1,559	72
Cool.	1,479	1,257	445	1,701	885	178	1,063	38
lights	8,949	7,607	2,685	10,292	5,895	1,879	8,774	33
Cook.	2,000	1,700	600	2,300	1,615	480	2,095	9
Refrig.	3,344	2,842	1,003	3,846	2,558	602	3,160	33
Process	14,907	12,671	4,472	17,143	12,045	3,577	15,623	9
Total	58,337	49587	17,501	67,088	33,837	9,083	43,920	36

Soft Path Strategy One Energy Demand By Energy Type

Energy Type	MBTU
Electricity	27,883
Natural Gas	16,037
Total	43,920

3.4 MUNICIPAL SOFT PATH: STRATEGY ONE PROJECTIONS

3.4.1 Methodology

Future energy demand in the Municipal Sector is expected to remain constant for the B.A.U. Scenerio with only a small increase in energy demand due to increased population-generated demand for water and sewer service. Future energy demand for municipal buildings, operations and vehicles is projected and described below.

3.4.2 Overview

Overall the Soft Path reduces Municipal Sector energy demand by 21 percent from the B.A.U. level. City governement will play an important role in achieving a desireable energy future for Marysville. The city can provide leadership by example, in incorporating an energy conciousness into all of its activities,from conservation and solar measures in existing structures and particularly in new ones, to the use of more energy efficient vehicles.

3.4.3 Buildings

The Soft Path energy demand reductions in buildings are limited to High Conservation measures, which together account for a 26 percent reduction in energy demand for buildings, as shown in Table 39. Rather than make assumptions concerning retrofit potential for the specific Municipal buildings, solar retrofit measures are not included. Detailed evaluation of each building is needed to assess the suitablity of solar applications. It was assumed that for the all electric city hall building that Soft Path Strategy Two measures could best supply electrial energy from photovoltaic installations or hydro-power on the nearby Blue River.

3.4.4 Operations

It is assumed that there will be little opportunity to make significant energy efficiency improvements in the water and sewer systems because of the long expected lifetime of the high capital equipment now in place. The major exception is if new capacity is added, particularly in the water supply system, which currently reaches maximum capacity during peak periods of the summer.

The most cost effective method of reducing energy demands for the existing water system is by reducing household usage and avoiding high peaks in demand. Energy efficient planning of new housing subdivisions will minimize future energy demand increases. Use of alternative systems such as greywater recycling and waste composting may also reduce energy demand for both existing and new residential service demands. These alternative practices could also lengthen the service life of the existing system by lessening service demand and delaying the need for adding capactity.

Energy demand for streetlighting receives the greatest percentage and the greatest amount of energy demand reduction. Currently low energy lamps are used in only a small portion of the streetlighting fixtures. It is assumed that further replacements could achieve a 40 percent reduction in electrical energy demand for streetlighting. This is often a very cost effective conservation measure with a cost payback of 1 to 5 years.

3.4.5 Vehicles

The energy reductions for municipal vehicles are primarily accounted for in the Transportation Sector where use of energy efficient vehicles and reduced number of vehicle miles traveled achieves a 65 percent reduction from the B.A.U. level.

TABLE 39

Strategy One Conservation in Existing Mun. Buildings

Soft Path, Year 2002

	Space Heat		Water Heat		Cooling		Light/Other		Total	
Building	Red. %	2002 MBTU	Red. %	2002 MBTU	Red. %	2002 MBTU	Red. %	2002 MBTU	Red. %	2002 MBTU
City Hall	-	173	(combined reduction 20% = 216)						12	389
Warehouse	40	455	10	32	-	-	10	49	37	536
Police	30	258	10	11	20	15	20	40	28	324
Others	20	268	10	20	20	134	25	158	21	573
Total									26	1822

Note: Refer to Chapter 1 for the B.A.U. end use energy demandfigures for each building.

TABLE 40

Municipal Soft Path Strategy One Summary

	1982	2002		
	Base	B.A.U	Soft Path: Conservation	
	E.D. MBTU	E.D. MBTU	Red. %	E.D. MBTU
Buildings				
City Hall	444	444	20	389
Police	449	449	28	324
Warehouse	848	848	37	536
Other	724	724	21	573
Sub. Total	2,465	2,465	26	1822
Operations				
Streetlight	1,740	1,740	40	1044
Water/Sewer	2,800	3,302	20	2642
Other	471	471	30	330
Sub-Total	5,011	5,513	20	4016
Total	7,476	7,978	27	5838

Post-Strategy One Energy Demand by Energy Type

	Buildings	Operations	Total
Electricity	785	3,438	4,223
Natural Gas	1,137	578	1,615

3.5 SCHOOLS SOFT PATH: STRATEGY ONE PROJECTIONS

3.5.1 Methodology

The exisiting schools are assumed to have sufficient capacity for expected increases in enrollments from population incresases in Marysville and the surrounding area. The B.A.U. Scenerio assumes the same energy demand as the 1982 base year.

3.5.2 Buildings

The focus of conservation efforts are on the two most energy inefficient school buildings, Central and Lincoln. A space heating energy efficiency target of 8.5 BTU/sq. ft./HDD, which is between the efficiency levels for the Junior and Senior High School buildings, is assumed for both Central and Lincoln schools. This translates to a reduction in estimated space heating energy demand of 32.5 percent for the Central school and 24.8 percent for the Lincoln school. For the electrical end uses, conservation measures are assumed to reduce energy demand by 25 percent, primarily through the use of energy efficient lighting replacements.

Since all the schools are located in relatively large open areas, it is assumed there is sufficient retrofit potential for solar space heating and water heating, shown in table 41. The Soft Path reduces total energy demand for the school sector by 37.1 percent from the Business As Usual level, as shown in the following table.

TABLE 41

Soft Path Strategy One Schools Cons./Solar Summary

	1982 Base/ B.A.U. Total	Soft Path Strategy One									
		Conservation				Solar				Total	
		Sp. Heat		Elec.		Sp. Heat		Wa. Heat			
School		Red. %	E.D. MBTU	Red. %	E.D. MBTU	Red. %	E.D. MBTU	Red. %	E.D. MBTU	Red. %	E.D. MBTU
Sr High	3,497	-	2,623	25	484	30	1,836	60	114	29	2,480
Jr High	4,487	-	2,942	25	670	30	2,059	60	326	29	3,185
Central	2,306	32.5	1,392	25	129	40	835	60	14	56	1,014
Lincoln	1,258	24.8	790	25	96	40	474	60	16	50	626
Other	1,794	-	1,708	25	65	40	1,025	-	-	39	1,090
Total	13,342		9,455		1,444	-	6,229	-	516	37	8,395

Strategy One Energy Demand by Energy Type

	MBTU
Natural Gas	6,951
Electricity	1,444
Total	8,395

3.6 TRANSPORTATION SOFT PATH STRATEGY ONE SCENERIO PROJECTIONS

3.6.1 Methodology

Unlike buildings or other energy use activities which have a definite location, the very nature of transportation is movement, which makes its definition and assessment more difficult. Only the local transportation energy demand is projected rather than the larger alternative energy demand estimated in Chapter 2.

What is transported, for what distance, by what mode are the basic components of the transportation system. Decisions made elsewhere by vehicle manufactures will probably have the greatest impact on the the transportation energy demand of Marysville. Although, as shown below there are many ways that the people of Marysville can influence transportation energy demands.

The following projections account for increased household and commercial related travel due to population increases. The B.A.U. projection assumes continuation of current trends in travel behavior and vehicle fuel efficiencies. From the projected B.A.U. transportation energy demand, two sets of Soft Path Strategy One scenerios, Low Conservation and High Conservation, reduce energy demand.

3.6.2 Conservation Considerations

Transportation energy demand can be reduced in four basic ways: 1) more energy efficient vehicles, 2) fewer trips, 3) intermodal shifts, and 4) increased load factors. These factors and the assumptions used for both the B.A.U. and Soft Path projection, are described below. The projections are detailed in table 42.

3.6.2.1 More Energy Efficient Vehicles

New cars can be made now at reasonable prices that get 60 and as high as 100 miles per gallon[62] Present federal law madates a fuel economy of at least 27.5 for new car models in 1985. How fast and how far these improvements penetrate the auto stock is in large part a function of fuel prices and the relative cost of the more efficient vehicles. Even at current fuel prices the added cost for, say a 60 MPG 4 passenger car, would pay back in one to four year, depending on the amount of travel.

For the following projections the B.A.U. Scenerio assumes that the 1985 federally mandated new car MPG will be met and that by 2002 the entire passenger auto stock will average 27.5 MPG, an 82

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[62] Amory B. Lovins and L. Hunter Lovins, Brittle Power, p. 246.

percent improvement over the 1982 base year MPG of 15.1. (This assumes that annually about 3 percent of the existing auto stock is replaced with at least 27.5 MPG autos.)

The Low and High Conservation Scenerios assume passenger auto fleet MPG's of 34.4 and 50, respectively.

3.6.2.2 Fewer Trips

Reducing the number of trips can have an immediate impact in energy savings. Walking and the use of bicycles could substitute for much of the local auto travel.

Statewide total vehicle miles traveled (VMT) per capita has increased about 24 percent between 1970 and 1980, or about 2.4 percent per year. the Business as Usual Scenerio, per capita VMT for the total vehicle mix is assumed to increase 2 percent a year from the 1982 base year level.[63]

For the Low Conservation scenerio, per capita VMT is assumed to remain at the 1982 base year level and the High Conservation Scenerio assumes a 10 percent reduction in year 2002 per capita VMT from the 1982 base year.

3.6.2.3 Intermodal Shifts

A shift away from less energy efficient modes of transportation to more efficient modes may have the most impact in Marysville on freight transportation. A comparison of different freight transport modes indicates the relative fuel efficiencies:[64]

Mode	BTU per ton mile of Frieght
Pipelines	450
Railroads	700
Waterways	700
Trucks	2,800
Air	42,000

Neither the B.A.U. nor the Low Conservation Scenerios assume any mode shift for freight transport (trucks). The High Conservation Scenerio assumes that since Marysville is a regional rail cross

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[63] DOE, 1981 Annual Report To Congress Volume 3, Energy Projections Feburary 1982, p. . Assumes per capita VMT will increase at an average annual rate of 1.6 percent.

[64] John H. Gibbons and William U. Chandler, Conservation Revolution, p. 204.

point that 10 percent of the medium truck and 25 percent of the heavy truck energy demand is replaced by rail transport (the rail energy is not accounted for here). Also the High Conservation Scenerio assumes a 5 percent decrease in auto VMT and 5 percent increase in motorcycle VMT. The higher MPG used for the motorcylce category assumes greater use of motorbikes for local travel.

3.6.2.4 Increased Load Factors

Passenger occupancy for many trips, particulary work trips, can be increased from one person to two or more, reducing vehicle miles traveled. A comparison of the efficiencies of various passenger transportation modes below indicates that car pools and van pools can greatly contribute to community transportation energy efficiency[65]

Mode	BTU per passenger mile
Single occupant auto	14,200
Average auto	10,200
New heavy rail transit	6,200
Carpool	5,500
Vanpool	2,400

The B.A.U. Scenerio assumes an increasing trend in per capita VMT (based on current statewide trends). The Soft Path Scenerio includes the impact of reduced per capita VMT which can be accounted for by both fewer trips and increased load factors.

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[65] John H. Gibbons and William U, Chandler, Conservation Revolution, p. 202.

TABLE 42

Transportation Energy Demand Projections, Year 2002

Business as Usual Scenerio

Vehicle Type	Number of Vehicles	Vehicle Miles Traveled	MPG	Fuel Use Gallons	Percent Fuel Use
Auto	4,459	8,851,420	27.5	321,870	54.6%
Light Truck	2,011	3,830,599	20	191,530	32.5
Medium Truck	158	300,975	9.5	31,681	5.3
Heavy Truck	187	355,698	9.5	37,442	6.4
Motorcycle	366	342,018	51	6,765	1.1
Total	7,181	13,680,711		589,288	100%

Low Conservation Scenerio

Vehicle Type	Vehicle Miles Traveled	MPG	Fuel Ues Gallons	Percent Fuel Use
Auto	6,029,716	34.4	175,282	59.%
Light Truck	2,609,460	34.4	75,856	25.5
Medium Truck	205,029	10.8	18,984	6.4
Heavy Truck	242,307	10.8	22,436	7.5
Motorcycle	232,988	51	4,568	1.5
Total	9,319,500		297,126	100%

High Conservation Scenerio

Vehicle Type	Vehicle Miles Traveled	MPG	Fuel Use Gallons	Percent Fuel Use
Auto	5,032,530	50	100,650	48.2%
Light Truck	2,348,514	34.4	68,271	32.7
Medium Truck	167,751	10.8	15,533	7.4
Heavy Truck	167,751	10.8	15,533	7.4
Motorcycle	671,004	75	8,947	4.3
Total	8,387,550		208,934	100%

Note: The number of vehicles for the Low and High Conservation scenerios is the same as for the B.A.U. scenerio.

Soft Path Strategy One Energy Demand By Energy Type For the High Conservation Scenerio

Energy Type	MBTU
Gasoline	23,216
Diesel	3,227
Total	26,443

Chapter IV

SOFT PATH STRATEGY TWO - RENEWABLE ENERGY SUPPLY

4.1 OVERVIEW

Soft Path Strategy Two approaches the energy supply side of the community energy system profile in developing the energy future scenerio projections for Marysville in the year 2002. Strategy Two assumes that the High Conservation/ High Solar measures have been implemented, thereby reducing energy demand to the lowest reasonable level. Therefore Strategy Two energy supply is matched with the post-Strategy One energy demand.

The amount of solar energy (insolation) falling annually within the Marysville city limits amounts to 21,216,720 MBTU, 57 times the energy demand for the 1982 base year, or 100 times more energy than the Post- Conservation/ Solar energy demand.[66] However, not all of this solar energy is available as a solar resource through solar technologies. Solar thermal technologies are, about at most 50 percent efficient and photovoltaics about 12 percent efficient.

The following is a brief survey of the potential renewable energy supply. It is by no means a complete analysis, particularly in terms of the wide variety of available technologies. Energy sources included are; wind, hydro-power, photovoltaics and municipal wastes. In considering the actual implementation of these options the cost involved is inseperable from the technical feasiblity. Therefore the next section describes the financial evaluation procedures that are included with the descriptions of the renewable energy resouce technology.

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[66] Solar energy (insolation) calculation:
City area = 42,000,000 square feet
Mean annual insolation per square foot = 136,875 (Langleys per day)
BTU's per Langley = 3.69
Annual BTU's per square foot= 136,875 x 3.69 = 505,069
Annual BTU's for Marysville = 505,069 x 42,000,000 = 21,216,720 MBTU ;Calculation Method from <u>County Energy Plan Guidebook</u>.

4.1.1 Cost Evaluation Of Options

In order to give some perspective on the direct economic costs associated with the various options several financial evaluations are calculated.[67] The different variables for the calculations are defined below and the specific assumptions for the calculation of the financial evaluation of Soft Path Strategy One are shown in Table 44 and for Strategy Two in Table 45.

1. Annual Power Output in MBTU, APO/MBTU - the estimated annual energy output for the particular option.
2. Annual Energy Savings, AES - the amount of energy saved.
3. Installed Cost Per Annual Power Output in MBTU's, IC/APO - in order to make an estimate of the cost involved of providing energy from each option a capital cost is estimated based on the cost per MBTU power output. Except where noted this cost will include the annual operating costs. Most of the figures used in calculating this cost are based on information in Brittle Power.
4. First Cost, FC - the estimated first cost involved for the particular option based on the above IC/APO.
5. Energy Type, ET - the type of energy displaced or supplied.
6. Projected Average Energy Price Per MBTU, PEP/MBTU - is the averageof the current and projected year 2002 price as shown in Table 44.
7. Annual Operating Cost, ACO - is assumed to be minimal in most cases usually 1 percent of the first cost.
8. Net Annual Energy Cost Savings, NAECS - the result of multipling the annual power output (APO/MBTU) by the projected energy price (PEP/MBTU) less the annual operating cost (ACO).
9. Estimated Lifetime, EL - the estimated lifetime of the equipment involved in the particular option.
10. Depreciation Charge, DC - a straight line depreciation charge which takes into account the depletion of the investment over its economic life by providing for renewal. Calculated by dividing the first cost (FC) by the estimated Lifetime (EL).

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[67] U.S. Department of Commerce, National Bureau of Standards in cooperation with the Federal Energy Administration, Energy Guide For Industry and Commerce, National Bureau of Standards Handbook 115 (Washingtion, D.C.: G.P.O., 1974), pp. 5-1 to 5-5.

11. Present Value, PV - used in the second level measures of performance which take into account the time value of money. The stream of benefits, or net savings, when constant in each time period, can be expressed in terms of present value by using a discount rate (DR) and summing the benefits over the expected lifetime of the project. The result is the present value of future savings.

4.1.1.1 First Level Measures of Performance

First level measures of performance are considered most useful in screening options for further evaluations. Included are:

1. Simple Payback Period, SPP - is defined as the first cost divided by the net annual energy cost savings, or FC - NAECS, expressed in years.

2. Return on Investment, ROI - takes into account the depletion of the investment using the straight line depreciation charge, expressed as a percent.

4.1.1.2 Second Level Measures of Performance

Second level measures of performance are those which incorporate an allowance for the time value of money, generally in the form or a discount factor. Because of alternative investment opportunities, a dollar held today is worth more than a dollar held some time in the future. Two discount rates are used. The 5 percent rate is appropriate for those options where "out of the pocket" financing can be used or with low or no interest charges. The 15 percent rate is appropriate where substantial interest charges are involved. The folowing two second level measures of performance are used.

1. Benefit/Cost Analysis - requires the direct comparison of the present value benefits (savings) generated by a given investment with its costs. Generally this is formulated in terms of a benefit/cost ratio. A ratio greater than one implies that the expected net benefits (properly discounted and summed over the lifetime of the investment) will exceed the initial costs and therefore such an investment is profitable.

2. Time to recoup capital investment - or the "breakeven" period, is similar in concept to the payback period, except that the breakeven period takes discount rates into consideration.

4.1.1.3 Score and Priority Ranking

A rough scoring method is used in order to give some relative priority ranking for each option. Strategy One measures are first scored and ranked independently of the Strategy Two, and then a overall ranking appears in the next chapter. The score number is determined by ranking the options for each financial evaluation measure, with one being the most favorable. Then the ranking for all four evaluations are added which is called the 'score' indicating the options overall position in the successive rankings. Again then, these scores are ranked with a final ranking score of one (1) indicating, in term of these evaluations, the most favorable option.

It is important to keep in mind that these are relatively simple traditional evaluation methods and do not incorporate positive or negative externalities which could greatly influence the outcomes.[68] For example, a more secure, resilient and democratic energy future is a premise of the Soft Path energy future whereas these outcomes are not attributed to the Hard Path. These positive benefits of the factors for the Soft Path and the negative aspects of the Hard Path are not included in these calculations. It is possible to assign monetary value to some of these factors and include in the calculations, but it is a much more involved process and is not attempted here. The point is that although these evaluations give an indication of the profiability of the investment in a particular option, they should not be viewed as the absolute determination of the desireability of the investment. A value weighted criteria could be developed by the people of Marysville that would help them to decide which measures are the most valuable.

The future price of non-renewable energy is difficult to predict, although there is a general consensus that the trend will certainly be upward, above general inflation. Current leading U.S. Department of Energy price projections by energy type per MBTU in 1980 dollars are shown in Table 43. The financial evaluations for each of the Strategy Two options are based on the average of the 1982 and year 2002 energy prices so that the cost savings represent the average savings over the life of the most of the investments.

It must be emphasized that these calculations represent only rough estimates. Each of the variables used in the calculations are subject to many uncertainties such as:

1. The initial capital costs,

2. The cost of financing,

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[68] Amory B. Lovins and L. Hunter Lovins, Brittle Power (Andover, Mass.: Brick House, 1982), pp. 284-288.

3. The amount of energy supplied,

4. The price of competing energy supplies,

5. Investment tax credits up to a total of 70 percent of the cost of the renewable energy system (see Appendix E).

TABLE 43

Energy Price Projections

Sector	D.O.E. 1979 Prices $/MBTU	D.O.E. 1995 Midrange Project. $/MBTU	D.O.E. Annual Percent Incr.	Marysville 1982 Prices $/MBTU	Marysville 2002 Prices $/MBTU	2002 Price Per Unit $	Ave. Wt. 1982/2002 Projected Price/MBTU $/MBTU
Residential							
Elec.	13.27	18.42	2.4%	18.76	30.95	.107/Kwh	24.86
Nat. Gas	3.03	8.73	7.8%	2.88	12.00	12.19/Mcf	7.44
(Commercial)							
Elec.	-	-	(3%)	13.84	24.91	.85/Kwh	19.38
Nat. Gas	-	-	(8.5%)	2.50	12.85	13.00/Mcf	7.65
Industrial							
Nat. Gas	1.94	7.65	9.5%	-	-		
Transport							
Gasoline	7.36	17.56	6.1%	9.59	31.34	3.92/gal	20.47

Note:
The D.O.E. projection did not have a commercial sector. The Marysville commercial natural gas price projection is based on the annual percentage increase slightly higher that that for the residential sector but substantially lower than that for the D.O.E. Industrial natural gas price projection. The commercial electricity annual rate of increase is slightly greater than that for residential, since its 1982 base price is much lower. The 2002 commercial electricity price is still lower than for the residential sector.

Source: U.S. Department of Energy, Energy Information Administration, <u>1981 Annual Report to Congress Volume 3, Energy Projections</u>, Feburary 1982, Executive Summary p. xx.

4.2 SOFT PATH STRATEGY ONE - CONSERVATION/SOLAR COST ESTIMATE

To complete the Soft Path Strategy One - Conservation Scenerio Projection, a rough estimate is made of the costs involved in achieving the energy demand reductions for all the sectors except transportation. For transportation it is assumed that there will be no major costs involved since transportation energy demand reductions are are primarily a matter of choice - less vehicle travel, purchase of more efficient vehicles, etc. - rather than dollar costs. The same is true for much of the energy conservation in the other sectors also - an energy consious attitude in choosing more energy efficient appliances, equipment, often at little or no extra cost.

An average cost of $45 per MBTU of electricity and $25 per MBTU of natural gas saved[69] is used to estimate the cost of efficiency improvements and retrofit measures for all sectors except transportation. A total of 192,082 MBTU is saved from the B.A.U. energy demand level. Of this it is assumed that 50,000 MBTU or 20.8 percent of the savings can be achieved at no extra cost (turning down thermostats, choice of equipment and appliances or energy conserving design of buildings). Of the remaining energy savings of 142,082 MBTU approximately 85 percent is natural gas and 15 percent is electricity. Therefore the estimated cost of conserved energy is estimated to be $3,019,243 for natural gas and $959,054 for electricity, for a total of $3,978,297. On a per household basis this total community energy savings would cost $2,122. Making this calculation for just the residential sector energy savings, the cost per household would be approximately $1,787.

The actual costs involved would probably include interest charges which could add substantially to the costs. Several ways of reducing this cost would be:

1. Contribution of lower cost or volunteer labor;
2. Grants and low interests loans;
3. Contributions of lower cost or free materials;
4. Tax credits and tax deductions.

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[69] Amory B. Lovins and L. Hunter Lovins, <u>Brittle Power</u>, p. 382 and 389.

4.2.1 Financial Evaluations

Assuming Current Energy Prices

1. Simple payback period = elec. 2.4 years; natural gas 8.7
2. Return on investment = elec. 36.7%; natural gas 6.5%
3. Benefit/Cost @ 15% d.r. = elec. 2.6; natural gas .7
   @ 5% d.r. = elec. 5.2; natural gas 1.4
4. Time to recoup investment @ 15% d.r. = elec. 3.5 yrs.;natural gas >25yrs.
   @ 5% d.r. = elec. 2.7 yrs.; natural gas 11 yrs.

Assuming Average of Current and Projected Energy Prices

1. Simple payback period = elec. 1.8 yrs.; natural gas 3.4 yrs.
2. Return on investment = elec. 50.2%; natural gas 25.8%
3. Benefit/Cost @ 15% d.r. = elec. 3.5; natural gas 1.9
   @ 5% d.r. = elec. 6.9; natural gas 3.7
4. Time to recoup investment @ 15% d.r. = elec. 2.2 yrs.; natural gas 5 yrs.
   @ 5% d.r. = elec. 2 yrs.; natural gas 4 yrs.

Score and Rank These Strategy One evaluations are considered here apart from the Strategy Two evaluations, so that the effect of using current and projected energy prices can be seen. At current prices, electrical measures rank higher than natural gas measures with a wide gap. At projected energy prices electrical measures still rank higher than natural gas measures but the gap is so close as to be negligble.

TABLE 44

Strategy One Financial Evaluation Assumptions

	Electricity		Natural Gas	
	1982 Price	Projected Average Price	1982 Price	Projected Average Price
APO/MBTU	21,312	- (same)	120,770	- (same)
IC/APO	45	-	25	-
FC/$	959,054	-	3,019,243	-
PFP/$	18.76	24.86	2.88	7.44
AOC/$	0	0	0	0
NAECS/$	399,813	529,816	347,818	898,529
EL/YRS>	20	-	20	-
DC/$	47,953	-	150,962	-
PV				
@15% d.r.	2,502,430	3,316,120	2,176,993	10,068,578
@ 5% d.r.	4,982,470	6,602,571	3,019,243	20,047,071

Note: See Cost Evaluation of Options section for key to symbols.
d.r. = discount rate.

4.3 HYDRO-POWER

Low head hydro is currently receiving attention nationally as a "new" source of electricity. Much of this activity centers on converting existing dams and refurbishing small hydro facilities. Lovins reports that:[70]

> some ten to twenty thousand megawatts of small hydro capacity was under reconstruction in 1981 (mainly refurbishing old, abandoned dams). A further twenty thousand megawatts at two thousand sites awaited permits in mid 1980 - twice the gross nuclear capacity ordered since 1975. It appears that the total small hydro capacity ordered during 1979 - 1981 in the U.S. amounted to more megawatts than the total coal and nuclear capacity during the same period - but small hydro plants can be ordered and producing power nearly a decade earlier than their steam plant competitors.

The Kansas Energy Office report, Kansas Hydro-Power - An Assessment of Low-Head Hydroelectric Opportunities lists 34 potential sites, totaling 394.2 million KWH annual energy production or about 1.5 percent of state's 1979 electrical generation.

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[70] Amory B. Lovins and L. Hunter Lovins, Brittle Power p. 364.

The Marysville site ranked 25th in the power output and 10th in a relative economic feasibility ranking. The following description of the Marsyville site is taken from the report:[71]

> Marysville Dam is also a former hydro-electric power plant of the Kansas Power and Light Company. The Marysville site was given to the City of Marysville intact. Powerhouse, generators and turbine sit as they were left over twenty years ago. The site is leased to the Kansas Fish and Game Commission for five years but little objection is expected for electric generation.

The estimated annual energy output for the Marysville site is 1.6 million KWH or 5459 MBTU which is about 8 percent of the 1982 base year total community electrical demand or 110 percent of the current total municipal electrical demand. In terms of post-Strategy One the hydro electrical supply could account for 8 percent of the total community electrical demand and 112 percent of the Municipal electrical demand. In addition to providing the city municipal electrical needs, saving as much as $100,000 per year, the surplus could be sold for nearly $15,000 at projected electrical prices.

The installed cost for small hydo-power equipment is reported by Lovins to be between $59 and 234 per MBTU of output. Based on the above description of the Marysville site it is assumed that capital equipment cost would be minimal. Therefore a cost of $50 per MBTU is used in the R.O.I. below.[72] Actual cost could be lower.

4.3.0.1 Financial Evaluations Assuming Projected Average Energy Prices

1. Simple Payback Period = 2.31 years
2. Return on Investment = 39.2%
3. Benefit/Cost @ 15% discount rate (d.r.) = 2.80
   @ 5% d.r. = 6.09
4. Time to recoup investment @ 15% d.r. = 3 years
   @ 5% d.r. = 2.5 years
5. Score = 6, Priority Ranking = 1 (of 6)

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[71] Kansas Energy Office, Kansas Hydro-Power - An Assessment of Low-Heat Hydroelectric Opportunities (U.S. DOE: Kansas City, MO, 1981) pp. 7, 11 and 15.

[72] Amory B. Lovins and L. Hunter Lovins, Brittle Power, p. 226.

4.3.1 Wind

The following introduction to wind power is taken from Lovins' Brittle Power:

> Windpower has the disadvantage (compared to flat-plate photovoltaics) of moving parts, but the considerable advantage of being able, in decent sites, to collect a great deal of energy from a relatively small machine. A machine which extracts only thirty percent of the power in the wind - reasonable performance for a good design without fancy equipment (tipvanes, shroud, variable pitch, etc.) - can extract neary twice as much power from a square yard of area swept through a eighteen-mile-per-hour wind as a square yard of ten-percent efficient solar cells can extract in bright sunlight. Furthermore, the average U.S. sunlight (direct plus diffuse) averaged over the day and year is only a sixth as strong as bright noon sunlight, whereas strong winds can blow at any time and tend to be especially common in cloudy winter weather. Accordingly, a simple wind machine in a good site can capture mechanical work very cheaply.

In assessing the potential of wind power in Marysville for electrical generation, the selection of a wind site for machines and an analysis of how much wind energy can be extracted are the first factors to consider.

The terrain surrounding Marysville is of gentle sloping hills. The wind blows from predominantly two directions: the northwest and south. For this reason, northwest and south facing slopes are the prime sites for locating wind machines. The hill on the north side of town is a great location for two reasons:

1. Closeness to the city will save on transmission line costs.
2. Wind machines create and can be combined with a shelterbelt to protect the city from north winter winds.

The second factor in assessing the wind power potential is the amount of wind available. Studies of the area reported in Kansas Wind Resource Assessment indicate that this site has average wind speeds between 14 and 18 miles per hour.[73] In areas were the mean wind speed is 10 mph or higher, wind machines are considered a potential viable source of energy.

The following assumptions are made for wind energy:[74]

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[73] Dr. Gary Johnson, 'Kansas Wind Resource Assessment, July 1980 - June 1982', Research Kansas State University, Report 151, August 1982.

1. 12 mph average annual wind speed (a conservative estimate).
2. 40 machines placed at the prime site discussed above.
3. Estimated actual energy output per machine:
   monthly - 2,428 kwh
   annual - 29,136 kwh (= 99.4 MBTU)
4. Installed cost per MBTU output = $140 (or $13,920 per machine)

4.3.1.1 Financial Evaluations Assuming Projected Average Energy Prices

1. Simple Payback Period = 6.33 years
2. Return on Investment = 10.80%
3. Benefit/Cost @ 15% d.r. = .96
   @ 5% d.r. = 2.09
4. Time to recoup investment @ 15% d.r. 22 years
   @ 5% d.r. 8 years
5. Score = 16, Priority Ranking = 4 (of 6)

4.4 PHOTOVOLTAICS

Photovoltaics (PV) utilize silicone chips of specific design and manufacture to produce electricity directly from sunlight.

> Photovoltaics are extremely durable, reliable and simple to use: when placed in the sun, they produce direct current, needing no maintenance unless they have a tracking concentrator. There is no chemical reaction inside them; nothing decays, discharges, or is consumed or given off.

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[74] The estimates of wind energy output are from work by Lisa Foster using the Kansas Energy Office publication Kansas Wind Energy Handbook, John Selfridge, ed. Installed cost per MBTU output from Brittle Power page 388. Note that improvements in wind machine production process are expected to significantly reduce wind machine costs.

> As with transistors in the 1950's and 1960's and intergrated circuits of the 1970's, the cost of solar cells has been falling dramatically.
>
> It is highly likely that (improvements in production processes) will achieve, on or ahead of schedule, the Department of Energy's 1986 array-price goal of seventy cents (1980 dollars) per peak watt, corresponding to a whole-system price of a dllar sixty to two dollars and sixty cents per peak watt at electricity prices comparable to or lower than those from a newly ordered central power station.[75]

Price targets for 1986 have been set by the U.S./D.O.E. which will make electricity from photovoltaics around 3 to 6 cents per kwh, comparable with todays prices.

Two basic applications for the use of photovoltaics have been assumed for Marysville. First, an ideal location for photovoltaics is on the roof tops of the downtown commercial buildings, for several reasons:

1. Access to sunlight is unobstructed,
2. The peak electrical demand for the downtown commercial businesses is during the day which is the time of the peak photovoltaic output, thereby avoiding the need for storage or selling excess output to the utility for less than purchase price. Supply is close to demand, thereby minimizing distribution losses and costs.
3. The total cost and overall effectiveness of the photovoltaic installation could be reduced through a coordinated design, purchase, installation and operation arrangement as compared to separate individual efforts.

4.4.1 Commercial Photovoltaic Electrical Output and Cost Calc.

Available flat rooftop in downtown Marysville was measured (from aerial photographs) to be 250,000 square feet. To estimate avaiable PV array area this total was first reduced by 25 percent for shading by parapet wall and adjacent buildings. Then based on the geometry of tilt angles in the winter mode (this is a conservatism since the summer mode would increase output) , a ratio of array area per unit roof area of 36 percent was determined: array area = 250,000 sq. ft. x .75 x .36 = 67,500 sq. ft. or 6273 square meters. Assuming a Pv efficiency of 12 percent and an average insolation of 5.5 Kwh/sq. meter/day it is possible to calculate the average PV

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[75] Lovins, Brittle Power p. 367

output: 6273 sq. meters x5.5 Kwh/m2/day x .12 = 4140.18 Kwh/day. Converting to MBTU's per year: 4140.18 x 3412 BTU/Kwh x 365 = 5156 MBTU/yr.

PV costs are based on a rating of peak power output or Kwp. The Kwp for our array is: 6273 square meteres x .12 x 1 Kw/m2 = 752.76 Kwp. Assuming the D.O.E.'s 1986 PV installed system price of $1.60/wp or $1,600 per Kwp, the cost for the downtown Marysville PV installation is: $1,600/Kwp x 752.76 Kwp = $1,204,416. The PV cost per electrical MBTU output is determined: $1,204,416 - 5156 = $233.6/MBTU.

4.4.2 Residential PV Electrical Output

The SERI study assumes a 1,176 square foot residence with a 380 square foot 4.5 Kw PV array. The PV electrical output for the annual insolation closest to that used for Marysville is 1,530 Kwh per year or (4.5 Kw x 1,530 Kwh = 6,885 Kwh) 23.5 MBTU/yr[76] which is more than the average electrical demand of 15.7 MBTU for the existing residences projected to survive. An adjustment is made so that the PV output is 15.5 MBTU/yr for three reasons, 1) to keep the first cost low , 2) because of the low utility buyback rates it is best to most closely match the output to demand, and 3) to reduce the roof square footage requirements.

Therefore since the output has been reduced by 34 percent the PV square footage is also reduced 34 percent to 250 square feet. Combining the roof square footage requriments for both solar thermal applications, 216 sq. ft. and PV, 250 sq. ft. the total is 466 sq. ft. This can be compared to a rough conservative estimate of the available south facing roof area of 650 sq. ft. for a 35' x 35' residence with a 4/12 pitch gable roof.

Secondly, the following assumptions are made for the residential photovoltaic applications in Marysville:

1. Photovoltaics are assumed for the 63% of the existing residences where there is high roof solar access of at least 225 square feet. Photovoltaics supply 15.5 MBTU or 99 percent of the average total electrical demand for the existing residences that are projected to survive. 714 existing residences x 15.5 MBTU = 11,067 MBTU.

2. Photovoltaic installations are assumed for all new residential construction with an averge electrical output of 15.5 MBTU per residence: 659 new residences x 15.5 MBTU = 10,215.

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[76] SERI, A New Properity p. 102.

3. Downtown commercial rooftop photovoltaic installations supply 23 percent (5155 MBTU) and other more dispersed commercial installations provide 20 percent (4477 MBTU) for a total of 43 percent (9632 MBTU) of the total electrical requirements for the existing buildings that survive to the year 2002. For new commercial buildings, photovoltaic installations are assumed to provide 50 percent of total electrical demand, 4,125 MBTU.

Commercial P.V. output:	MBTU
existing - downtown	5,156
other	4,477
new Buildings -	2,475
Commercaial total	12,107

Residential P.V. output:	
existing -	11,067
new construction -	10,215
Residential Total -	21,282

Total annual photovoltaic output in Marysville for the year 2002 is estimated to be 33,389 MBTU. The estimated total cost of the PV installation is 33,389 MBTU x $233.6/MBTU = $7,799,670.

4.4.3 Financial Evaluations Assuming Projected Average Energy Prices

4.4.3.1 Residential

1. Simple payback period = 9.4 years

2. Return on investment = 6.64%

3. Benefit/Cost @ 15% d.r. = .69
   @ 5% d.r. = 1.50

4. Time to recoup investment @ 15% d.r. = >25 years
   @ 5% d.r. = 13 years

5. Score = 20, Priority Ranking = 5 (of 6)

4.4.3.2 Commercial

1. Simple payback period = 12.05 years

2. Return on investment = 4.3%

3. Benefit/Cost @ 15% d.r. = .55
   @ 5% d.r. = 1.17

4. Time to recoup investment @ 15% d.r. = >25 years
@ 5% d.r. = 19 years

5. Score = 23, Priority Ranking = 6 (of 6)

4.5 MUNICIPAL WASTES

Two types of municipal wastes are included here, solid waste (trash) and sewage. One important way of utilizing the solid waste stream that is not included in this evaluation is the recycling of those items which can be resued or reprocessed, especially oil, aluminium, paper and ferrous metals. Recycling would save energy at the factory and produce income in its sale.

The solid waste is estimated to contain approximately 9 MBTU's per ton, of which approximately 60% can be converted to useable energy.[77] At least two methods can be used to extract the energy 1) land filling and subsequently tapping the methane gas produced by the bio-deradation of the waste, 2) the material can be burned to produce steam or can be processed to produce a refuse derived fuel for burning. The city is estimated to generate approximately 2800 tons of solid waste per year.[78] The potential energy output for solid waste is estimated to be: 9 MBTU/ton x .6 = 15,120 MBTU/year.

Sewage waste is produced at a rate of about 235,000 gallons per day or 85.8 million gallons per year.[79] According the the CONAES study[80] anaerobic digestion of sludge can produce up to 600 Btu's per cubic foot of sludge. There are approximately 4.5 gallons to a cubic foot or 133 BTU's per gallon of sludge, or (85.8 million gallons x 133 Btu/gal.=) 11,411 MBTU.

It is assumed that either liquid or gas produced from the biomass conversion is substituted for liquid trasportation fuel (gasoline or diesel).

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[77] Deborah Kupa, A Community Energy Plan For the Town of Richmond, (Prepared by thqe Graduate Cirriculum in Community Planning and Area Development, University of Rhode Island, n.d.), p. 42.

[78] James Benson and Alan Okagaki, County Energy Plan Guidebook, p. 7-13.

[79] From interview with Marysville sewage plant operator,fall 1982.

[80] Lincoln Planning Department and Lincoln Energy Commission, Comprehensive Community Energy Management Program - Part II, (Lincoln, Nebraska: n.p., April 1981), p. 32.

The first cost of $60 per MBTU output is the average for the reported costs of various 'thermochemical bioconversion' processes.[81]

4.5.0.3 Financial Evaluations Assuming Projected Average Energy Prices

1. Simple payback period = 3.0 years

2. Return on investment = 30.0%

3. Benefit/Cost @ 15% d.r. = 2.1
   @ 5% d.r. = 4.2

4. Time to recoup investment @ 15% d.r. = 4 years
   @ 5% d.r. = 3 years

5. Score = 7, Priority Ranking = 2 (of 6)

4.6 WOOD

Nationally the use of wood has increased dramatically. Lovins reports that in New England that the use of wood increased by about 24 percent between 1978 and 1980. Also "wood made up nearly three quarters of the total 1980 renewable energy supply and provided a quarter of northern New England's space heating". [82]

It is difficult to describe the potential contribution of wood energy without an assessment of the carrying capacity of the available land and what a reasonable output would be. It is possible though that a properly managed woodlot could provide a portion of the community's energy needs. Wood can be converted to liquid fuels but will be considered here as replacement for natural gas space heating. Here it is assumed that wood could repace 20 percent of the year 2002 natural gas space heating energy demand, 9334 MBTU. The average post-Strategy One residential natural gas energy demand is is 48 MBTU, assuming wood energy replaces about 50 percent of the natural gas, therefore 24 MBTU per household, and dividing the 9334 MBTU by 24 MBTU equals 389 households would be involved. A rough estimate of $500 is used as theaverage per household first costin order to utilized wood. Lovins reports that wood costs about $80 per MBTU delivered with a 50% efficient stove.[83] Although this cost could be reduced considerably by cooperatives.

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[81] Amory B. Lovins and L. Hunter Lovins, Brittle Power, p. 386.

[82] Ibid., p. 227.

[83] Ibid., p. 383.

4.6.0.4 Financial Evaluations Assuming Projected Average Energy Prices

1. Simple payback period = 5.6 years

2. Return on investment = 13.8%

3. Benefit/Cost @ 15% d.r. = 1.1
   @ 5% d.r. = 2.2

4. Time to recoup investment @ 15% d.r. = 14 years
   @ 5% d.r. = 7 years

5. Score = 11, Priority Ranking = 3

TABLE 45

Assumptions for Strategy Two Financial Evaluations

			PV			
	Hydro	Wind	Resid.	Comm.	Muni.Waste	Wood
APO/MBTU	5,459	3,976	21,282	12,107	26,531	9,334
ET	elec.	elec.	elec.	elec.	oil	Nat. gas
IC/APO/$	50	140	233.6	233.6	60	12.5
FC/$	272,950	556,780	4,971,475	2,828,195	1,618,391	195,500
PFP/$	22.12	22.12	24.86	19.38	29.73	13.32
AOC/$	2,730	5,568	0	0	16,184	76,672
NAFCS/$	118,023	82,381	529,045	234,634	543,090	34,723
EL/yrs.	25	25	25	25	25	25
DC/$	10,918	22,271	198,859	113,128	64,736	4,680
PV ($000)						
@ 15% d.r.	762	532	3,419	1,559	4,606	310
@ 5% d.r.	1,663	1,161	7,456	3,306	10,033	618

Note: The Strategy One - Conservation/Solar First Cost is based on energy saving of 142,082 MBTU.

Chapter V

MARYSVILLE SOFT PATH ENERGY FUTURE SCENERIO SUMMARY

5.1 ENERGY DEMAND SUMMARY

Energy demand by sector has been projected to the year 2002 by sector under a Business-As-Usual scenerio which resulted in a 20.4% increase in total energy demand. Soft Path Strategy One measures reduce energy demand by 53.4 percent from the B.A.U. level. From the post- Strategy One energy demand level, Strategy Two supplies 35.1 percent of the remaining energy demand. Overall the Soft Path Scenerio achieves a 70.4 percent reduction in community energy demand from the B.A.U. level. A summary of total energy demand for the different projections is shown in Table 46 and on a per capita basis in Table 47. The projected energy demand profiles are shown graphically in Figure 24.

TABLE 46

Energy Demand Projections Summary

	Business As Usual				Soft Path: Strategy One			
Sector	Elec. MBTU	Nat Gas MBTU	Oil MBTU	Total MBTU	Elec. MBTU	NatGas MBTU	Oil MBTU	Total MBTU
Resid.	55,362	231,683	-	287,045	34,612	90,606	-	125,218
Comm.	4,930	42,158	-	67,088	27,883	16,037	-	43,920
Muni.	5,514	2,464	-	7,978	4,883	1,615	-	5,838
Scho.	1,925	11,417	-	13,342	1,444	6,951	-	8,395
Transp.	-	-	74,412	74,412	-	-	26,443	26,443
Total	92,601	287,852	74,412	449,865	68,162	115,209	26,443	209,814

Soft Path Strategy Two

Energy Type	Strategy One Amount Saved MBTU	Post-Strat. One Energy Demand MBTU	Strat. Two Energy Supply MBTU	Final Demand MBTU
Electricity	24,439	68,162	42,824	25,338
Natural Gas	167,643	115,209	9,334	105,875
Oil (gasoline)	47,969	26,443	26,531	-88
Total	240,051	209,814	73,689	133,125

TABLE 47

Per Capita Total Projected Energy Demand

	Per Capita MBTU	Change From 1982 Base %	Change From B.A.U. %
1982 Base Year	101	-	-
Business-As-Usual	100	-1	-
Soft Path:			
Strategy One	46.6	-53.9	-53.4
Strategy Two	29.6	-70.7	-70.4

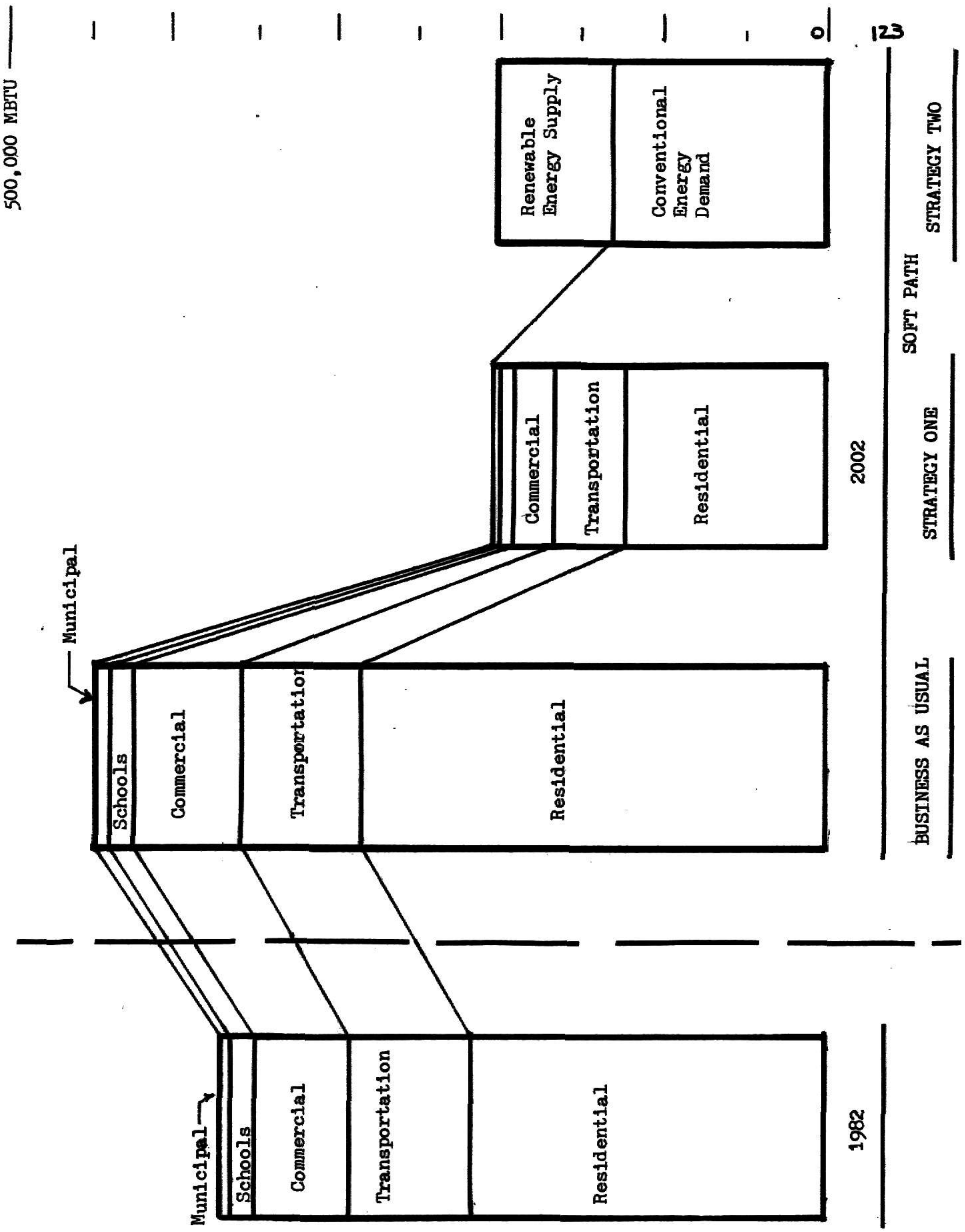

Figure 24: Total Energy Demand Projections

5.2 ESTIMATED COST OF SOFT PATH CONSERVATION MEASURES

The cost of Soft Path Strategy One energy conservation measures must be estimated before we can make a final economic comparison of the two scenerios. The cost of the Soft Path measures are calculated on a per household basis.

5.2.1 Strategy One

Since 75 percent of the households are assumed to participate, the total cost of Strategy One conservation measures for electricity and natural gas from Table 44 ($3,978,297) is divided by 1406 households (.75 x 1875), which equals $2,829. This can be compared to the estimated savings over twenty years (Cummulative Fuel Cost Savings For Participating Households = $56,730,380 divided by 1406) equals $40,349 per household. It is likely that most households would have to borrow money to implement many of the measures, but this could be offset by the substantial tax savings (as much as 70 percent).

5.2.2 Strategy Two

The costs of implementing Strategy Two measures are assumed to be shared by all households all though larger users would assume a larger part of the total cost. Total cost of Strategy Two measures from Table , ($10,442,291) is divided by 1875 households, equal $5,569. Again tax savings could offset much of the borrowing costs. This cost can be compared to the estimated conventional fuel cost savings over twenty years (Cummulative Fuel Cost Savings for 20 years = $33,542,800) equal $17,889 per household. The combined cost per household for Soft Path measures is $8,398. Dividing this cost over 20 years equals $420, which approximates an annual payment on borrowed cost of the Soft Path measures. The combined Soth Path conventional fuel cost savings equals $58,238 or $2,912 per year over 20 years.

5.2.3 Projected Costs of Conventional Energy

Projected energy costs are calculated based on the energy demand from Table 46 and the projected year 2002 per unit energy prices from Table 44. If the energy dollar drain of 87 percent, as estimated for 1982, continues, the year 2002 Marysville energy dollar drain will be $7,369,463 which is 15.8 percent of the projected total household income (1875 x $24,900 = $46,687,500).

TABLE 48

Summary of Year 2002 Projected Energy Costs

	B.A.U.			
	Elec.	Nat.Gas	Oil	Total
Residential	$1,713,454	$2,780,196	-	$7,218,242
Commercial	742,318	539,622	-	1,646,552
Municipal	137,356	31,539	-	197,108
Schools	47,952	146,138	-	324,814
Transport.	-	-	3,710,926	3,710,962
Total	$2,641,080	$3,497,495	$2,332,072	$8,470,647

	Soft Path: Strategy One and Two			
	Elec.	Nat.Gas	Oil	Total
Residential	$119,550	$604,664	-	$724,214
Commercial	393,036	205,897	-	598,310
Municipal	105,195	20,672	-	125,867
Schools	35,970	88,973	-	124,943
Transport.	-	-	(-4,389)	(-4,389)
Total	$653,751	$919,563	$(-4,389)	$1,570,576

5.2.4 Household Energy Costs

Household energy costs are calculated based on the same projected energy prices for the B.A.U. and Soft Path scenerios and in the same manner as the earlier calculation for 1982. First, real household income is projected to increase at a rate of 1 percent a year[84] from $16,000 to $19,525 in the year 2002. As shown in Table 49 projected energy costs under the B.A.U. scenerio account for 28.1 percent of household income and under the Soft Path projected energy costs account for 9.8 percent of household income. The Soft

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[84] The assumed rate of increase for household income is based on a review of personal income data from several recent publications including Kansas Economic Report prepared by Kansas State University and the University of Kansas and Kansas Annual Planning Information, 1983 prepared by the Kansas Department of Human Resources; the Gross National Product Price Deflator from the Statistical Abstract of the United States, U.S. Department of Commerce, Bureau of the Census, is the basis for the inflation adjustment.

Path energy conservation measures result in a
percent decrease in household energy costs.

TABLE 49

Projected Household Energy Costs As A Percent Of Income

	B.A.U.		Soft Path			
			Strat.One		Strat.Two	
	Cost	%/In.	Cost	%/In.	Cost	%/In.
1. Average Residentail Energy Costs	$2,397	12.3%	$1,151	5.9%	$388	2.0%
2. Average Household Energy Costs	$3,370	17.3%	$1,523	7.8%	$388	2.0%
3. Average Household Share Total Community E.Costs.	$4,718	24.2%	$2,216	11.3%	$838	4.3%
4. Average Household Share Of Total Community Energy Costs Based On Alternative Transport..	$5,494	28.1%	$3,298	16.9%	$1,920	9.8%

Note: The alternative transportation calculation is based on the projected annual per capita fuel consumption of 236 gallons reported in the the Department of Energy 1981 Annual Report to Congress, p. 41. The 1982 alternative transportation energy estimate was about 2.8 times as large as the local transport energy. Since an alternative transport estimate was not considered in the Strategy One measures it is assumed that the Soft Path alternative transport estimate is 2 times as large as the local transport energy or 162 gallons per capita.

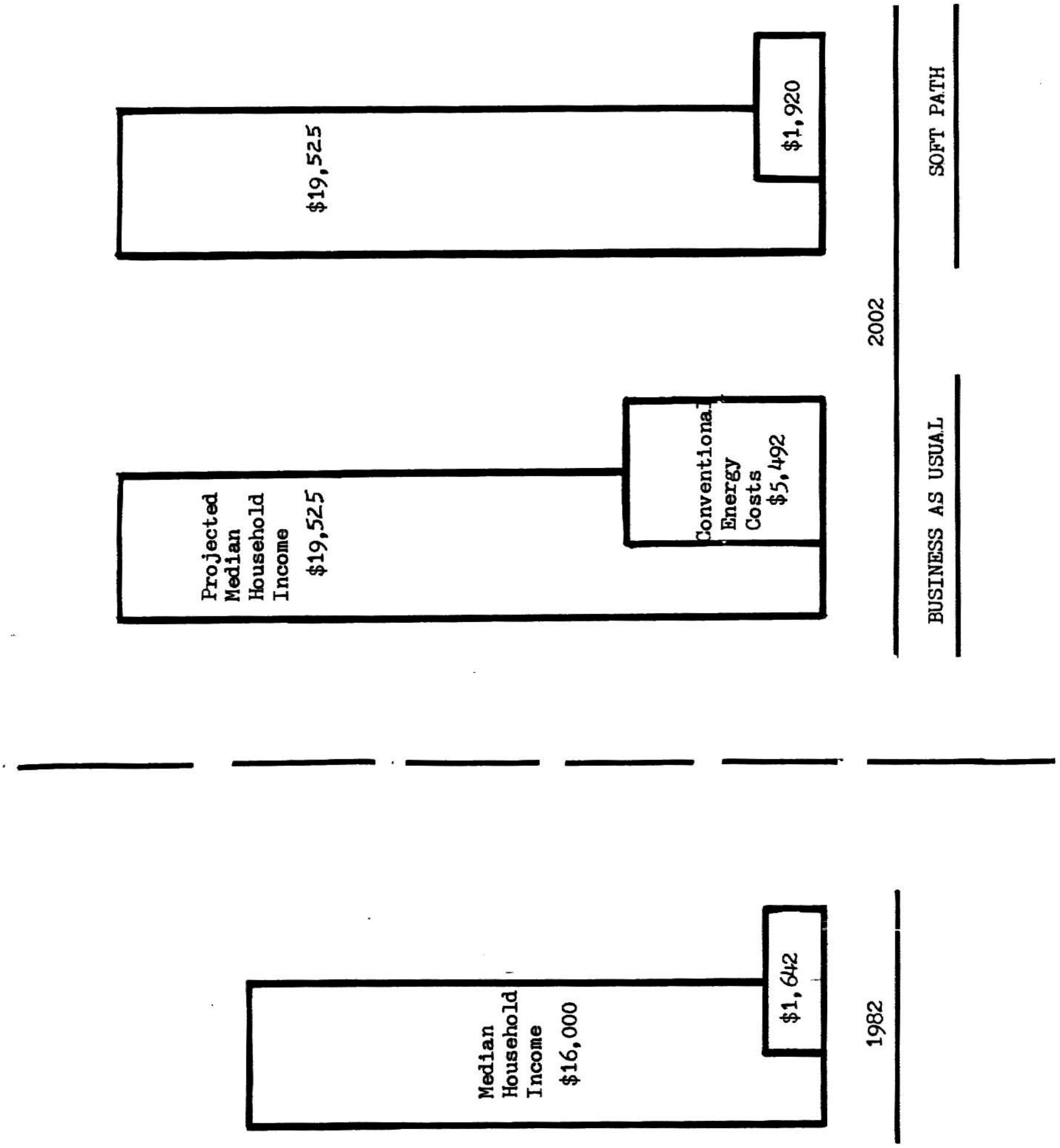

Figure 25: Projected Average Household Share Of Total Community Conventional Energy Costs

5.2.5 Energy Conservation and Job Creation

An estimate can made of the number of jobs that could be created through theimplementation of Strategy One - Conservation/Solar measures. It is estimated that the amount of labor required to install conservation measures similar those decribed in Strategy One is 45 person-years of labor for each million dollars spent.[85] Therefore $4 Million dollars (from Table the total of the first cost for electricity and natural gas) x 45 = 180 person years. In other words if a conservation program lasted one year 180 jobs would be created. If it took two years 90 jobs would be created, etc. A significant number of other jobs would be created by the Strategy Two measures.

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[85] Elizabeth Schaefer and James Benson, Energy and Power In Your Comunity (Fairfax, Virginia: Institute for Ecological Policies,1980), p. 51.

Chapter VI

CONCLUSIONS

Before making some community energy management planning recommendations, this final chapter first attempts to pull back from the local perspective and look at the 'big picture'.

6.1 THE BIG PICTURE

The structure of the complex energy system of the U.S. makes it impossible to realisticaly assess the Marysville energy system in insolation from other energy systems (regional, state, national even international). A local energy system can be studied apart from the larger energy systems to which it is tied, but, for a more complete understanding of the energy system a broader perspective is essential.

6.1.1 National Energy Insecurity

"The U.S. has for decades been undermining the foundations of its own strength. Its had gradually built up an energy system prone to sudden, massive failures with catastrophic consequences."[86] The failures may be caused by natural events, usually weather related such as the 1984 winter ice storm that caused much of north eastern Kansas to be without electrical power for up to several weeks in some areas. Accidents may also be the disruptive cause, as was the case in the winter of 1983 when a major natural gas pipeline near Marysville was briefly cutoff. Perhaps the most serious kind of energy insecurity arises from deliberate human actions. "Such actions may arise either outside the United States (wars, embargoes, interruptions of commerce) or domestically (sabotage, terrorism, riots, strikes, oligopolistic withholdings of supply, judicial injunctions, permit suspensions, declarations of air pollution emergency). Some of these disruptions spring from a desire to harm the system. Others are pursued with commendable motives, not in order to shut off energy supplies; but the result con be equally disruptive."[87]

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[86] Amory B. Lovins and L. Hunter Lovins, Brittle Power, p. 1.

[87] Ibid., p. 14.

Energy insecurity is not the only 'big picture' energy related problem. Energy and environmental issues are inseperable. The extraction, conversion, transportation and distribution of energy impacts every part of the human and natural environment - air pollution and acid rain, oil spills, coal mining and nuclear radiation all cause damage to the man nature. In the current energy system the end user of energy is not aware of the actual social and environmental cost associated with the delivery of the energy.

Energy use and the environment conflict at the local level and at the global level. There is concern about the CO problem associated with fossil fuel use and possible deforestation. Icecap melting and climatic shifts which may arise as much from particulates accumulating in the atmosphere as from greenhouse effect caused by CO buildup are potential problem of tremendous importance. importance[88]

6.1.2 Community Energy Management Planning

Community energy management planning addresses the issues outlined above from a "ground up" approach by designing and building resiliency into the local energy system. A resilient energy system absorbs shock more easily than as a rigid system; that is when stressed it gives way gracefully without shattering."[89] A resilient energy system would incorporate passive and active resilience. "Thus 'passive resilience' describes the mere ability to bounce without breaking; active resilience connotes the further adaptive quality of learning and profiting from stress by using it as a source of information to increase 'bounciness' still further. In the spirit of this metaphor, a rubber ball has passive resilience; the nerves and muscles of someone learning to play basketball have active resilience. Systems on which our nation depends need both, but most energy system currently have neither.

The following is an outline of some of the priciples of design science for resilience:[90]

1. Fine-grained modular structure
2. Early fault detection
3. Redundancy and substitutability

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[88] John H. Gibbons and William U. Chandler, Conservation Revolution, p. 104.

[89] Ibid., p. 179.

[90] Ibid., pp. 191 - 206.

4. Optional interconnection
5. Diversity
6. Standardizations
7. Dispersion
8. Hierarchical embedding
9. Stability
10. Simplicity
11. Limited demands on social stability
12. Accessibility

Soft Path Strategy One of this report described how resilience can be built into an existing community energy system by improving end use energy efficiency of providing the ergy service - that is, by wringing more work out of the energy so that the same service is provided, with unchanged reliability and convenience, in a more cleaver way that uses less energy. Soft Path Strategy Two described a resilient energy supply system

> "which consists of numerous, relatively small modules with a low individula cost of failure. This is quite different from the approach presently followed by most energy companies and governments - vainly trying to build high technical reliability into modules so large that their cost of failure is unaccepable. The philosophy of resilience, on the other hand, accepts the inevitability of failure and seeks to limit the damage that failure can do. For example, rather than suffering a prolonged regional or national failure that can shatter the whole economy, one might occasionally have to tolerate a day of two or reduced production in a individual factory - rather like what happens now when a single fossil-fueled industrial boiler breaks down.
>
> "Second, a resilient supply system delivers energy to its users via short short, robust links. Energy that travels simply and directly from one's own roottop, or down the street, or across town, is more likely to arrive than energy that must travel hundreds or thousands of miles and be processed and converted in complex devices along the way."

Even though the main arquement for pursuing the Soft Path energy future instead of the allowing a B.A.U. scenerio to take over was made on economic grounds - that it will be cheaper in the long run than not following the Soft Path - an equally important arquement can be made on the energy security and related environmental issues outlined above. Thus even if the energy prices were not to increase as much as was assumed in this report there are other equally important reasons for pursuing the Soft Path energy scenerio.

6.2 RECOMMENDATIONS

The evidence seems overwhelming that the energy transition can be an opportunity to create a more self-reliant, affordable and sustainable energy/economic future for Marysville. It is hoped that the Marysville Energy Study can serve as an educational tool to increase understanding of the Marysville energy system and energy issues in general. Ultimately it is the concern and efforts of the Marysville people will transform their actions into a desireable energy /economic future.

Creating a desireable energy/economic future includes at least the following basic elements.

6.2.1 Vision

Vision in both the minds of individuals and the community as a whole that "a secure supply of energy, used efficiently, is necessary to assure a sound economy, maintain a clean and healthful environment, and minimize expenditures within our cities, states and the nation."[91] The vision becomes a flexible guide for individual and community action.

6.2.2 Leadership

Leadership -

> "Knowing who is important in the process of local energy decision making is as important - if not more important than - knowing what the community's energy problems and potentials are. Energy decision makers constitute a large, extremely heterogeneous group of actors: suppliers, converters and distributors, major commercial and industrial users, government agencies and of course a host of individual consumers. Their decisions, individually and collectively, determine the way energy is delivered and used in a locality. The interests of each actor needs to be accommodated in any community energy

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[91] Michael J. Meshenberg, Guidebook For Establishing A Local Energy Management Program p.1.

management program.

> "The reader is asked to keep two things in mind while considering, as a means of identifying potential participants in a local energy management process, the array of institutional actors involved in a community system. First, although different actors have different levels of involvement, improving the system must involve a wide range of community interests. It is necessary to appreciate each of those interests so that that potential contribution of each actor to system improvement can be identified. Second, community energy management is intensely political. As in any political process, it is essential to understand the individual motivations, processes and legal or organizational limitations that define the behavior of each participant in order to encourage all participants to make their identified contributions. The most reliable motivator is self-interest. Therefore, a goal of the local program manager is to point out how certain actions will promote the interests each actor represents, while at the same time increasing the efficiencyof the community energy system and thereby improving the welfare of the community as a whole."[92]

6.2.3 <u>Tools and Techniques</u>

A set tools and techniques are needed that can move individuals and the community toward the vision. Below is a listing of the basics. An excellent guide for more information on on these is <u>Guidebook For Establishing A local Energy Management Program</u>.

1. Information and Education,

2. Public Policy Declarations and Persuasion,

3. Contingency Planning,

4. Demonstration Projects,

5. Incentives,

6. Municipal Regulations,

7. Special Financing Mechanisms.

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[92] Micheal J. Meshenberg, <u>Guidebook For Establishing A Local Energy Management Program</u>, pp. 35-36.

6.2.4 Steps

Initially perhaps only a few of the above tools are appropriate for Marysville to include in the development of local energy management program. The following outline of items for the first and second years and beyond is presented as a starting point in taking steps toward a vision of Marysville's energy future.

1. Year One - objective is to educate, organize and succeed at taking some initial steps toward reducing total household and community energy demand and cost. This will provide a foundation for encouraging further activities.

   Form a Marysville Energy Committee to coordinate activities and to provide a focus for responsibility. The Committee could be appointed by the city council and would include an Energy Coordinator that would be at least a half-time paid position. Suggested tasks include:

   a) Promote energy education and awareness throughout the community. For example make energy issues and participation in energy related activities the topic for civic group meetings and school classrooms.

   b) Since weatherization measures are the most cost-effective and show immediate savings, a goal should be set for weatherizing a certain number of homes, say 100 for the first year. To accomplish this a home energy audit program could be used to identify those homes with the greatest need, especially low and fixed income households. Donations could be taken to provide weatherization materials. To lower the cost of materials downtown merchants and homeowners could establish a cooperative for bulk buying. Workshops could show how to do low cost/ no cost weatherization measures. Local service groups could be trained to provide free labor or charge according to a sliding income scale.

   c) Households that participate in energy conservation efforts should be recognized by the community as a reward for their efforts, since the whole community will benefit. The recognition can also give encouragement to others and provide demonstrations of the kinds of measures. A suggested method for doing this would be to establish an 'Energy Conservation Home Of The Month Award' which could appear in the local newspaper. A annual community banquet could honor the yearly winners.

2. Year Two - would be the time to evaluate progress, continue existing efforts and to work to involve the entire community in developing a community energy plan.

a) The Marysville Energy Committee might organize a week long energy fair which could include a tour of energy conservation award homes, and special workshop classes and discussion groups through the Marysville Free University. The week could conclude with a town meeting that reviews the year's accomplishments and establishes permanent sub-committee's to study problems, options and to make recommendations. Discussions should encourage free and open participation from the whole community, and all ideas should be considered. Examples of sub-committees and tasks as a part of the energy fair are:

   i) Residential - set new goal for weatherizing homes; set goal for solar retrofits; establish awards for street, block and neighborhood accomplishments; start solar hot water worshops and set goal for a certain number of installations.

   ii) Municipal/Community-Wide - encourage the start of energy related small businesses; establish regulations for siting and energy performance of new construction; establish a ride share program; develop an emergency energy plan.

   iii) Commercial - set goal for weatherizing commercial buildings; study cogeneration potential.

b) Finally the ideas that arise from the energy fair committees would be presented to the whole group. The items would then be prioritized and formulated into a plan. General goals are established that are in line with the Marysville community vision. Objectives would be set and tools and methods selected to accomplish them. The Marysville City Council should be involved as much as possible so that the plan can be adopted as an official policy tool.

3. And Beyond - the Energy Committee and sub-committees continue work on implementing measures to accomplish objectives. Eventual consideration of measures such as: revising zoning, sub-division and building regulations, recycling program, municipal solar utility, increasing local food production for local consumption and incorporating a more bioregional approach to community energy planning that would include an emphasis on the agricultural sector.

6.3 CONCLUSIONS

The report has described the components of the Marysville community energy system for the base year 1982 and the future of that system according to the assumptions of two projected scenerios. Based on this description it possible and in the best interests of the welfare of the community to proceed with a community energy management program to reduce the community's dependence on conventional nonrenewable energy resources and to develop a secure, affordable and reliable supply of local renewable energy resources. Clearly not to do so will be very expensive and investing in a transition to an energy future based on conservation and renewable resources, while not cheap, will certainly be cheaper than not doing so. There are many other social, political and economic reasons why Marysville should become involved in community energy planning other than the direct household economic costs, but it is the people of Marysville that will ultimately need to find their own spark that will motivate the community to action.

Perhaps the following can summarize some basic principles for finding the spark and guiding the action.

Regaining control of energy and its costs involves the recognition of the inherent power and relevance of the local community.

> "Generations of 'centralized decision-making' have weakened the ability of individuals and communities to actively participate in the democratic process. Citizens must be re-empowered to make their own decisions and take appropriate actions. Apathy can only be countered by developing self- worth which can result from taking action to bring about a measureable result. Not only does this approach best ensure the success of an energy venture, but it gives citizens a renewed sense of self-worth and the power to work cooperatively with neighbors in bringing about improvements in other aspects of community

life."[93]

An important principle for guiding the Community Energy Planning Process is Fairness or Equity. Fair and equitable allocation of resources and opportunities is a basic premise of our democracy. This concept should even be extended to future generations, in that we should recognize and assume a moral responsibility for passing on a just society and a secure and affordable energy/economic future. Maximizing participation of all citizens, especially the poor, in decision-making processes is one way of making the future more fair and just.[94]

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[93] Mari Peterson and Diane Tegtmeier, Kansas Energy - a resouce guide for community action Volume III: Community Wookbook, p.9.

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[94] The author explored these ideas concerning planning and the responsible use of resources in a paper Planning by Design. Two important sources for the paper were Responsibilities To the Future a collection of articles edited by Ernst Partridge and A Theory of Justice by John Rawls.

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Appendix A

GLOSSARY OF TERMS

Energy Conversion Factors:

Electricity - 1 Kwh = 3412 Btu
Natural Gas - 1 MCF = 1,016,000 Bth's
Gasoline - 1 gallon = 125,071 Btu's
Diesel - 1 gallon = 138,000 Btu's

BTU (British Thermal Unit) - a unit used to measure quantity of heat; the quantity of heat required to raise the temperature of one pound of water 1 degree F. One BTU is approximately equal to the amount of heat given off by one kitchen match.

Infiltration - - the uncontrolled movement of outdoor air into the interior of a building through cracks around windows and doors or in walls, roofs and floors. This may work by cold air leaking in during the winter or the reverse in the summer.

Heating Degree Day - an expression of a climatic heating requirement expressed by the difference in degree F below the average outdoor temperature for each day and an establish indoor temperature base of 65 degree F. (The assumption behind selecting this base is that average construction will provide comfort when the exterior temperature is 65 degree F.) The total number of degree-days over the heating season indicates the relative severity of the winter in that area.

Langley - the meteorologist unit of solar radiation intensity, equivalent to 1.0 grams calorie per square centimeter, usually used in terms of langley per minute. 1 langley per minute = 221.2 BTU per hour per square foot.

R-factor - a unit of thermal resistance used for comparing insulating values of different materials; the reciprocal of the conductivity; the higher the R-factor of a material the greater its insulating properties.

U - Value - (coeffecient of heat transfer) - the number of BTU's that flow through one square foot of roof, wall or floor in one hour, when there is a 1 degree F. difference in temperature between the inside and outside air under steady state conditions.

The following definitions describe the dwelling thermal characteristics used for the Marysville Residential Survey.

Energy Conservation & Renewable Resource Measures

LES The Audit

Federal law requires LES to estimate the potential energy savings if certain energy conservation or renewable resource measures are installed in a "typical home."

To calculate these potential energy savings, a "typical home" is assumed to be: single story, light frame construction, 1,500 sq. ft., 10 years old, 3½ in. fiberglass insulation in attic, 1½ in. fiberglass insulation in walls, combination aluminum storm windows and doors, fireplace, fully heated basement, natural gas furnace and water heater, and electric central air conditioner.

Installation of these measures requires a financial investment, and often requires skills beyond the ability of the average homeowner.

It is important to remember that energy savings depends on many factors. The estimates that follow are based on the assumed "typical home." The potential costs and savings in your residence will be different if your house is different, or if your family is a different size and your energy-using habits are different from those we assumed in performing these calculations. T.H.E. Audit that LES offers will provide more specific estimates for your individual home.

Caulking is the application of pliable materials such as sealants, putty, or glazing compounds to reduce the passage of air and moisture by filling small gaps. This includes at fixed joints of your home, underneath baseboards inside your home, in exterior walls at electrical outlets, around pipes and wires entering your home, and around dryer vents and exhaust fans in exterior walls. Caulking of a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 2 and 3 percent over a one-year period.

Weatherstripping is the application of narrow strips of material over, or in, movable joints of windows and doors. It reduces the passage of air and moisture to and from your home. Weatherstripping a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 3 and 4 percent over a one-year period.

Furnace efficiency modifications are changes you can make in your heating system so it uses less fuel. Two modifications may be recommended. One is replacing your furnace, boiler or heat pump with one of the same fuel type that uses less fuel; the other is replacing the burner unit in your oil furnace with a more energy-efficient one. Making furnace efficiency modifications in a home heated by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 12 and 25 percent over a one-year period.

Replacement of central air conditioner means replacing your existing central air conditioner with a more energy-efficient one of the same fuel type. This will reduce the amount of fuel consumed to cool your home. Replacing the central air conditioner in a home cooled by electricity, gas, or an electric heat pump could result in an energy cost savings of between 1 and 8 percent over a one-year period.

Ceiling insulation is a material that resists heat flow between the conditioned (heated and cooled) area of your home and an unconditioned area. When the conditioned area of your home extends to the roof, ceiling insulation is the material used on the underside of the roof. Adding insulation to your uninsulated or inadequately insulated attic or roof will help reduce the loss of heated air in the winter and cooled air in the summer. Insulating the ceiling in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 4 and 6 percent over a one-year period.

Wall insulation is a material that is installed within or on the walls between conditioned (heated and cooled) and unconditioned areas of your home, and between the conditioned area and the outside. Adding insulation to your uninsulated or inadequately insulated walls will help reduce the loss of heated air in the winter and cooled air in the summer. Insulating walls in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 2 and 4 percent over a one-year period.

Floor insulation is a material that is installed between the first level conditioned (heated and cooled) area of your home and an unconditioned basement or crawl space, or an exposed surface beneath your home. Where the first level conditioned area is a ground-level concrete slab, floor insulation is the material installed around the perimeter of, or on, the slab. In the case of mobile homes, it means the skirting which encloses the space between the building and ground. Insulating an uninsulated or inadequately insulated floor will help prevent the loss of heated air in the winter and cooled air in the summer. Insulating the floor in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 9 and 11 percent over a one-year period.

Duct and pipe insulation is a material installed around ducts and pipes located in areas of your home that are not heated or cooled. It prevents the loss of heated and cooled air and water. Insulating ducts and pipes in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 17 and 20 percent over a one-year period.

Water heater insulation is material placed around your water heater to reduce heat loss. Insulating a water heater in a home heated by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 2 and 3 percent over a one-year period.

Storm or thermal windows are, respectively, windows or a glazing material placed outside or inside an ordinary or prime window, creating an air space, to provide greater resistance to heat flow; and windows with two or more parallel sheets of glazing material installed in the window sash to create insulated air space, to reduce heat flow. Installing storm or thermal windows in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 9 and 11 percent over a one-year period.

Storm or thermal doors are either a second door, installed outside or inside a prime door, creating an insulating air space; a door with enhanced resistance to heat flow through the glass area because there are two or more sheets of glazing material; or a prime exterior door with an R-value (resistance to heat flow) of at least two. Installation of storm or thermal doors in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 2 and 4 percent over a one-year period.

Heat reflective and heat absorbing window or door material is a glazing material with exceptional heat-absorbing or heat-reflecting properties. It is also absorptive or reflective films and coatings applied to an existing window or door which results in exceptional heat absorbing or heat reflecting properties. Installing heat reflective and heat absorbing window or door material in a home heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 1 and 3 percent over a one-year period.

A clock thermostat is a device designed to reduce energy consumption by regulating the demand on your heating or cooling system. It automatically lowers the thermostat setting during the heating season and raises it during the cooling season. Installing a clock thermostat in a home that is heated and cooled by electricity, gas, oil, or an electric heat pump could result in an energy cost savings of between 8 and 16 percent over a one-year period.

Direct gain glazing systems are passive solar systems that use south facing panels of insulated glass, fiberglass, or similar transparent substances to admit the sun's rays into your home where the heat is retained. The panels are either single- or double-paned and are equipped with movable insulation. Installation of this measure in a residential building could result in a heating energy cost savings of between 10 and 25 percent over a one-year period.

Indirect gain systems are passive solar systems that use panels of insulated glass, fiberglass, or similar transparent substances to direct the sun's rays onto thermal walls, ceilings, rockbeds, or containers of water or other fluids, which store and radiate heat. Installing an indirect gain system in a residential building could result in a heating energy cost savings of between 9 and 30 percent over a one-year period.

Solaria/sunspace systems are passive solar systems that use a structure made of glass, fiberglass, or similar transparent substances attached to the south facing wall of your home, allow air circulation to bring heat into your home, and can be closed off from your home when sunlight is unavailable. Installation of a solaria/sunspace system in a residential building could result in a heating energy cost savings of between 11 and 24 percent over a one-year period.

Window heat gain retardants are passive solar mechanisms that significantly reduce summer heat gain through south-facing windows. Examples are awnings, internal and external insulated roll-up shades, metal or plastic solar screens, or movable rigid insulation. Installation of window heat gain retardants in a residential building could result in an energy cost savings of between 1 and 3 percent over a one-year period.

Kansas

Kansas Incentives for Renewable Energy Measures

Kansans may claim a tax credit equal to 30% of a renewable energy systems' installed cost to a maximum of $1,500. Generally, active and passive solar and wind energy systems providing heat, mechanical or electrical energy are eligible. To claim credit, file Kansas Form K35 with supporting schedules.

An individual's tax liability is reduced by the credit. Any unused credit may be carried forward for two years or until exhausted. For example, if the installed cost of a solar system for preheating domestic hot water is $2,500, the system owner is eligible for a $750 tax credit. With an annual tax liability of $200, the owner would pay no state income tax for three years and would, in fact, receive a $50 cash refund in each of those years. When the annual liability is $500 or more, any refund will be made in the third year.

When a passive solar system, such as a greenhouse, sunspace, trombe wall, sky light, or thermal storage mass, is individually or in combination included in the structure of the home, the expenses apart from the homes conventional construction costs may be claimed for a credit.

Additional Incentives
Active solar and wind energy systems are exempted from personal property tax for the 1980 through 1985 tax years. Property tax exemption forms are available from the Kansas Department of Revenue, Division of Property Valuation, 913-296-2365. Systems installed before the end of 1980 and designed to provide 70% of a dwelling's heating or air conditioning, qualify for a 35% property tax refund in each of five consecutive years following installation. File Kansas forms K60 and K60A to apply for a property tax refund.

Kansas Incentives for Residential Insulation

Kansans may reduce their taxable income up to $500 by adding insulation to their home. Fifty percent (50%) of the installed cost may be claimed for insulating walls, ceilings and floors of homes built by July 1, 1977. File Kansas Form K36 for this deduction.

Applications for Kansas Tax Incentives. Questions concerning these incentives and application procedures should be addressed to the Kansas Department of Revenue, Second Floor, State Office Building, Topeka, Kansas 66612 (913-296-3051). General information may be obtained from the Kansas Energy Office, 214 West Sixth Street, Topeka, Kansas 66603 (913-296-2496).

Federal

Federal Incentives for Renewable Energy Measures

Income tax credits of 40% of the installed cost of solar, wind and geothermal energy systems used to heat, cool, provide domestic hot water, or electricity to an individual's principal residence, may be claimed up to $4,000. Any credit exceeding an individual's income tax liability may be carried over to succeeding years until exhausted or through 1987. A taxpayer installing a qualifying system may claim a credit whether or not the residence in which the system is installed continues to be the taxpayer's principal residence for the life of the credit. To claim the credit, file IRS Form 5695.

An individual installing a $7,500 solar space heating system may claim a $3,000 tax credit. With an average annual tax liability of $1,300, the claimant's tax liability may be completely offset for two years and reduced by $400 in the third year. Only the individual installin a qualifying system may claim the credit. The system must be expected to last five years and may not be claimed for credit if financed with non-taxable federal, state or other cash awards.

Some passive solar system components are eligible for credit. Claimants should review IRS Form 903 or contact the IRS before making application.

Appendix B

MARYSVILLE RESIDENTIAL ENERGY USE SURVEY

The survey results are shown on the actual survey forms. The percentage of respondents indicating a certain response is shown in the small box next to the possible responses for each question. N or the number of useable responses is 55, unless otherwise noted.

MARYSVILLE RESIDENTIAL ENERGY AUDIT
INSTRUMENT #1 - QUESTIONAIRE

INTERVIEW ID ☐☐ DATE ☐☐

INTERVIEWER ID ☐☐ TIME ☐☐☐☐

1. Dwelling Type

- 94.5 % Single family detached
- 0 Duplex (choose unit 'A' or lowest number)
- 5.4 Mobile/Modular
- 0 Single family unit - Multiple occupancy
- 0 Apartment house (three or more units)
- 0 % Other explain(____________________)

NOTE: INTERVIEW ONLY THE FIRST THREE(3) TYPES OF UNITS. IF UNIT IS ONE OF LAST THREE(3) TYPES, STOP HERE. PICK A NEW UNIT FROM THE RESERVE LIST AND START AGAIN WITH A NEW INSTRUMENT.

I would like to begin by explaining the parts of this survey and what will be involved with each part. First of all, your house was chosen at random to be included in a sample of the homes in Marysville. There will be 3 parts to this survey.requiring 2 visits by our investigators. The first part is an interview which we can do now or sometime in the next couple of days at your convenience. It will take about 30 minutes to complete. The second part is a questionaire which we will leave for the head of the household and , if applicable, the spouse to independently fill out. These should take about 15 minutes to complete. The third part will consist of some measurements of the house to be taken at the time the questionaire(s) are picked up.

You do not have to take part in this survey. If you choose not to be involved, there will be no obligation to do so. Participation is entirely voluntary. You may, if you wish, terminate the interview at any time for any reason. This is not a test. There are no right or wrong answers, and your responses will be kept entirely confidential.

In keeping with the KSU Human Subjects Research Policy, I would like for you to sign this statement to show that I have read it to you, that you understand it, and that you agree to be interviewed.

____

NOTE - INTERVIEW ONLY HEAD OF HOUSEHOLD OR SPOUSE

I would like to begin by asking who lives here. I would like to know their relation to the head of the household, their age, if they work and in what kind of job.

Job Classifications		
	1. N.A.	6. Professional
	2. Unemployed	7. Management
	3. Retired	8. Clerical
	4. Disabled/Unable	9. Agricultural
	5. Housewife	10. Labor/Manual
		11. Other

Dwelling occupants by relation to Head of Household.	N	Age	Sex M	Sex F	Job Class	Respondent? N	Respondent? Y
1. Head of Household	55		61.8 %	38.2 %			
2. Spouse	36		11.1	88.9			
3. Child 1	24		29.2	70.8			
4. Child 2	14		35.7	64.3			
5. Child 3	7		71.4	28.6			
6. Child 4	4		75.0	25.0 %			
7. Other	1		100				
8. Other	1		100 %				
9. Other	0						

(HAND RESPONDENT CARD # 1)

0. From the categories on this card, when would you say this house was built?

1.8 %	Don't know
18.2	1982-1960
25.5	1959-1940
30.9	1939-1920
9.1	1919-1900
12.7	1899-1880
1.8 %	before 1880

Do you own this home, pay rent, or what? N.R. = 1

87.3 % owns or is buying

7.3 % rents

5.5 % neither owns nor rents

How is that? __________

____

(go to 44)

(HAND RESPONDENT CARD # 2)

Could you tell me the group on this card that would indicate about how much rent you pay a month, not including utilities.

☐ Under $100
☐ 100-149
☐ 150-199
☐ 200-249
☐ 250-299
☐ 300-349
☐ 350-399
☐ 400-449
☐ 450-500
☐ 500 and more

(go to 44)

(HAND RESPONDENT CARD # 3)

Could you tell me the group on this card that would indicate what the present value of this home is. What would it bring if you sold it today.

N.R. = 1

55.3 % Below 40,000
12.8 40,000-49,999
19.1 50,000-59,999
4.3 60,000-69,899
0 70,000-79,999
4.3 80,000-89,999
2.1 90,000-99,999
21 % 100,000-109,999
☐ 110,000-119,999
☐ 120,000 and above

(go to 44)

The next few questions are about the types of energy used in this home and what they are used for.

ENERGY USE

==

		none	D.K.	nat. gas	elect.	L.P.	Oil	Wood	Solar	Other
44. What energy source do you use most for heating this home? N.R. = 1	%	0	0	90.9	5.5	0	0	3.6	0	0
45. Which, if any, secondary energy source is used for heating this home? N.R. = 1	%	54.5	1.8	3.6	16.4	3.6	0	16.4	0	36

(PROBE OR LOOK)

(FOR ANY RESPONSE OTHER THAN "WOOD", GO TO NEXT PAGE)

WOOD CONTINGENCY left side of box = "Most" N = 2 ; Right side of box = "secondary" N = 9

46 Estimate how many cords of wood you used last winter.

%0 ☐ 62.5	0 ☐ 32.5	50 ☐ 0	50 ☐ 0	0 ☐ 0	0 ☐ 0	0 ☐ 0
# of cords = >1	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6 & more

47 What do you do most? (READ RESPONSES)

%0 ☐ 37.5%	%0 ☐ 12.5%	100% ☐ 50%	☐ ____________
buy your wood	get it free	cut your own	or do you do something else (what is that)

Please answer yes or no as to whether or not you use the following types of wood burners in this home.

	%	%
48 A Fireplace without glass doors	0 ☐ 33.3 yes	100 ☐ 66.7 no
49 A fireplace with glass doors	0 ☐ 44.4 yes	100 ☐ 55.6 no
50. New type, air tight woodstove	100 ☐ 22.2 yes	0 ☐ 77.8 no
51. Old type woodstove	0 ☐ 0 yes	100 ☐ 100 no
52. Any other?	50 ☐ 0 yes	50 ☐ 100 no

Please explain ____

==

		non	D.K	nat gas	ele	L.P	Oil	Woo	Sol	Oth
53. What energy source do you use most for water heating? N=53	%	0	0	94.4	5.6	0	0	0	0	0
54. Which, if any, secondary energy source do you use for water heating? N=53	%	94.3	1.9	0	3.8	0	0	0	0	0

(PROBE OR LOOK)

=== 150

		none	D.K.	nat. gas.	elect.	L.P.	Oil	Wood	Solar (Clothesline)	Other
55. What energy source do you use most for clothes drying at home? N=54	%	5.6	1.8	11.1	61.1	0	0	0	20.4	0
56. Which, if any, secondary energy source do you use for clothes drying at home? N=54	%	48.1	0	1.9	11.1	0	0	0	35.2	3.7

(PROBE OR LOOK)

	yes	no
57. Do you have an outside clothes line available to you? N=52	86.5	13.5

===

		none	D.K.	nat. gas.	elect.	L.P.	Oil	Wood	Solar	Other
58. Which energy source do you use most for cooking in the home? N=54	%	0	0	18.5	81.5	0	0	0	0	0
59. Which, if any, secondary energy source do you use for cooking in the home? N=53	%	77.4	0	13.2	5.7	0	0	1.9	0	1.9

(PROBE OR LOOK)

Please answer 'yes' or 'no' to indicate whether or not you regularly use the following appliances.

	yes		no	
60.	59.3	%	40.7	Crock Pot N=54
61.	35.2		64.8	Microwave oven N=54
62.	24.5		75.5	Convection oven N=53
63	7.4		92.6	Electric roaster N=54
64.	60.4		39.6	Automatic electric coffeemaker N=53
65.	52.8		47.2	Other - What is that?____________

controlling the temperature of this home during the winter? N=55

98.2 % yes   1.8 % no (go to 70)

(HAND RESPONDENT CARD # 4)

67. From the categories on this card, where during the daytime in the winter is the thermostat set? N=55

%	0	0	0	11.1	46.3	38.9	1.9	1.9
	below 50	50-54	55-59	60-64	65-69	70-74	75-80	80+

68. Do you set back your thermostat at night in the winter? N=54

66.7 % yes   33.3 % no (go to 70)

(HAND RESPONDENT CARD # 5)

69. From the categories on this card, to what temperature N=36 do you set your thermostat back?

%	0	5.6	16.7	27.8	50	0	0	0
	below 50	50-54	55-59	60-64	65-69	70-74	75-79	80 and above

==

70. Do you use any method for summer cooling such as airconditioners, whole house fans, or the like? N=55

100 % yes   0 % no (go to 77)

Please answer 'yes' or 'no' to whether or not you use these methods of summertime cooling? N=55

	yes	no (go to 73)
71. window airconditioner	43.6 %	56.4 %

How many window airconditioners do you use? N=24

72. %	79.2	20.8	0	0	0	0
	1	2	3	4	5	more than 5

N=55

	yes	no
73. Central airconditioner	60.0 %	40.0 %
74 Swamp Cooler	0	100
75 Whole house fan	18.2	81.8
76 Window, floor or ceiling fans	76.4	23.6

==

Please answer 'yes' or 'no' to indicate whether or not in the last few years or in the months since you have lived here, you have added to or changed any of the features listed below. N=55

77. Attic Insulation — 36.4 % no — 63.6 % yes (please explain) ____________________

78. Wall Insulation — 47.3 no — 52.7 yes (please explain) ____________________

79. Caulking — 34.5 no — 65.5 yes (please explain) ____________________

80. Weatherstripping around doors and windows — 44.4 no — 55.6 yes (please explain) ____________________

81. Storm doors — 32.7 no — 67.3 yes (please explain) ____________________

82. Storm windows — 31.5 no — 68.5 yes (please explain) ____________________

83. Regularly installed plastic on the windows — 87.3 no — 12.7 yes (please explain) ____________________

84. Room additions — 87.3 no — 12.7 yes (please explain) ____________________

85. Any solar options — 96.4 % no — 3.6 % yes (please explain) ____________________

86. Because of its relation to energy use, could you tell me if there have been any periods of more than 2 weeks in the past 12 months, or in the months you have lived here, when the house has been nearly or completely unoccupied?

78.2 % no — 21.8 % yes (please explain) ____________________

87. For the same reasons, could you tell me if in the last 12 months, or in the months you have lived here, have you had extra people come to stay with you for more than 2 weeks at a time?

90.9 % no — 9.1 % yes (please explain) ____________________

The next few questions deal with plant growing activities in and around this home. I will be using the word 'garden' in a general sense to mean any or all plant growing activities; (including vegetable gardening, flower gardening, etc.

88.

GARDENING

Did you have a garden this year?

no	yes
32.7 %	67.3 %

(go to 106)

89. Could you tell me why? (WRITE AS NEARLY AS POSSIBLE A VERBATIM RESPONSE) N = 37

1.1% - like fresh produce
8.2 - enjoy/recreation
.8 - economics
.9 - other

90. In this or in previous homes, how many years have you had a garden N = 36

1-5yr.	6-10yr.	more than 10 years
25.0 %	11.1 %	63.9 %

91. In season, about what percent of the household needs does the garden provide. N = 35

0-24%	25-49%	50-74%	75-99%	100+%
68.6 %	14.3	14.3	2.9	0

These questions are about categories of plants grown in your yard and in your garden. Answer 'yes' for the ones you grow, and 'no' for the ones you do not.

	yes	no
92. Annual vegetables?	88.9 %	11.1 %
93. Perennial vegetables?	44.4	55.6
94. Perrenial flowers outside?	11.4	88.6
95. Annual flowers outside?	14.3	85.7
96. Fruit trees?	56.7	43.2
97. Nut trees?	77.1	22.9
98. Berry Bushes?	82.9	17.1
99. Indoor plants and flowers?	17.1 %	82.9 %

100. Do you preserve some of your garden production? N=36

no	yes
25	75

no → go to 112

yes → Indicate with a 'yes' or 'no' whether or not you regularly use the following preservation methods. N=27

	no	yes	
101.	☐	81.5	canning
102.	☐	88.9	freezing
103.	☐	0	drying
104.	☐	14.8	other - what is that?________________

____

105. Compared to other people you know who preserve food, would you say you preserve much more, more, the same as, less, or much less than they do? N=26

much more	more	the same as	less	much less
3.8	26.9	23.1	26.9	19.2

(GO TO 112 ON NEXT PAGE)

Could you tell me why you don't have a garden? (MARK 'YES' ON THE ONES THAT ARE MENTIONED, AND 'NO' ON THE ONES WHICH ARE NOT MENTIONED.) N= 18

		yes	no
106.	No suitable space	50.0	☐
107.	Not interested	38.9	☐
108.	Physically unable	16.7	☐
109.	No time	27.8	☐
110.	Not necessary	22.2	☐
111.	Other (DESCRIBE)	16.7	☐

____

____

===

112. As a result of the information gathered from this research project, future studies which involve more detailed measurements may be undertaken using homes such as yours. If such a study were undertaken, would you be interested in being involved? N=54

74.1	25.9
yes	no

(THIS ENDS THE INTERVIEW)

REMEMBER TO DO THE FOLLOWING:

1. Ask the respondent to fill out and sign the fuel release form.

   ☐ DONE

2. Explain the survey forms and leave 1 or 2 for the head of household and/or spouse to fill out INDEPENDENTLY.

   ☐ DONE

3. Make an appointment for the Measurements Team to pick up the surveys, answer any questions about the surveys, and to do their physical features and solar suitability assessments.

   APPOINTMENT TIME/S ☐

4. Thank them for their time and cooperation.

ID#__________ ID# of address_______ address__________

STRUCTURAL FEATURES

Indicate in the space below the degree to which the features of this house meet the standards indicated in the last column.

	Percent of Standard							
	0	25	50	75	100	NA	Standard	
Attic Insulation	10	13.3	60	10	6.7	☐	R-38	N=30
Wall Insulation	16.6	10	16.6	0	56.6	☐	R-11	N=32
Crawlspace Insulation	87.5	-	-	6.3	6.3	☐	R-11	N=16
Floor Insulation	82	3.6	7.1	3.6	3.6	☐	R-19	N=28
Sill Area Insulation	77.8	☐	8.3	2.8	11.1	☐	R-19	N=36
Double/Triple glazed or Storm Windows	2.4	☐	4.8	7:1	85.7	☐	all	N=42
Storm Doors	9.5	☐	4.8	7.1	78.6	☐	all	N=42
Caulking	31.8	6.8	15.9	18.2	27.3	☐	all	N=44
Weatherstripping	42.9	7.1	14.3	4.8	31.0	☐	all	N=42
Plastic on Windows	75	☐	15	☐	10	☐	all	N=20

Answer 'yes' or 'no' to whether or not these features are present in this home.

	NA	yes	no	
Heat Pump	☐	7.3	92.7	N=41
Duct and Pipe Insulation	☐	7.3	92.7	N=41
Hot Water Tank Insulation	☐	9.8	90.2	N=41
Solar Greenhouses, or extra windows for solar gain	☐	8.1	96.9	N=37
Active Solar Domestic Water Heating	☐	0	100	N=37
"Breadbox" Solar Water Heating	☐	0	100	N=37
Active Solar Space Heating	☐	0	100	N=37

STRUCTURAL FEATURES

Indicate in the space below the most appropriate answers for the features of this residence.

FRAME

93.5 wood studs N=46

2.2 conc./masonry

0 steel studs

43 other ____________________

SIDING MATERIALS

86.4 wood, shingle, metal, vinyl, asbestos, or masonite siding

6.8 1/2 stone/brick and 1/2 wood

4.5 all stone or all brick

2.3 stucco/cement

SOLAR SUITABILITY ASSESSMENT

When using the compass, do not stand near any metal objects or heavy electrical lines. Either of these can cause the compass to give an improper reading.

When using the compass, remember that TRUE SOUTH is 8 degrees west of magnetic south which the compass reads.

The calibration markings on the compass are in 2 degree increments.

Sketches should contain the following:

1. basic shape and orientation of the residence
2. any south walls, windows, and doors
3. basic plan of the roof
4. any pertinant information about the site and surroundings

The shading calculator sketches should have noted on them deciduous trees on the site, deciduous trees off the site, coniferous trees on the site, coniferous trees off the site, and any other obstructions.

A SPECIAL WORD OF CAUTION please be careful with the compasses, any compass either lost or broken will be paid for by the group that compass was assigned to.

To determine 10 - 2 winter on the "SHADE CALCULATOR" USE below the Sept/March line.

To determine 10 - 2 summer on the "SHADE CALCULATOR" USE above the Sept/March line.

INDICATE IN THE SPACE BELOW THE BEST ANSWER IN EACH SECTION, THEN FOLLOW THE ARROWS TO THE NEXT SECTION.

SKETCHES

AREAS (WALLS)

- ☐ less than 10 ft^2 → wash-out go to roof
- ☐ 10 - 32
- ☐ 33 - 64
- ☐ 65 - 96
- ☐ 97 - 120
- ☐ 121 - 160
- ☐ 161 - 192
- ☐ 193 - 224
- ☐ 225 + ft^2

→ ORIENTATION

ORIENTATION

- ☐ 0 - 15° E or W of South → ACCESS TO SUN
- ☐ 16 - 30° E or W of South → ACCESS TO SUN
- ☐ 31 - 45° E or W of South → ACCESS TO SUN
- ☐ 46 - 60° E or W of South → ACCESS TO SUN
- ☐ 61 - 75° E or W of South → wash-out go to roof
- ☐ 76 - 90° E or W of South → wash-out go to roof

ACCESS TO SUN

- ☐ No Access → OBSTRUCTION
- ☐ 10-2 winter only → PERCENTAGE ACCESS
- ☐ 10-2 summer only → PERCENTAGE ACCESS
- ☐ 10-2 anytime → PERCENTAGE ACCESS

OBSTRUCTION

- ☐ Conifer → PERCENTAGE ACCESS
- ☐ Deciduous → PERCENTAGE ACCESS
- ☐ Wall/Fence → PERCENTAGE ACCESS
- ☐ Building → wash-out go to roof

PERCENTAGE ACCESS

- ☐ less than 40%
- ☐ 40 - 54%
- ☐ 55 - 69%
- ☐ 70 - 84%
- ☐ 85 - 100%

RESIDENCE FT^2 → ☐

LIST AREAS OF ROOMS NOT USED IN WINTER

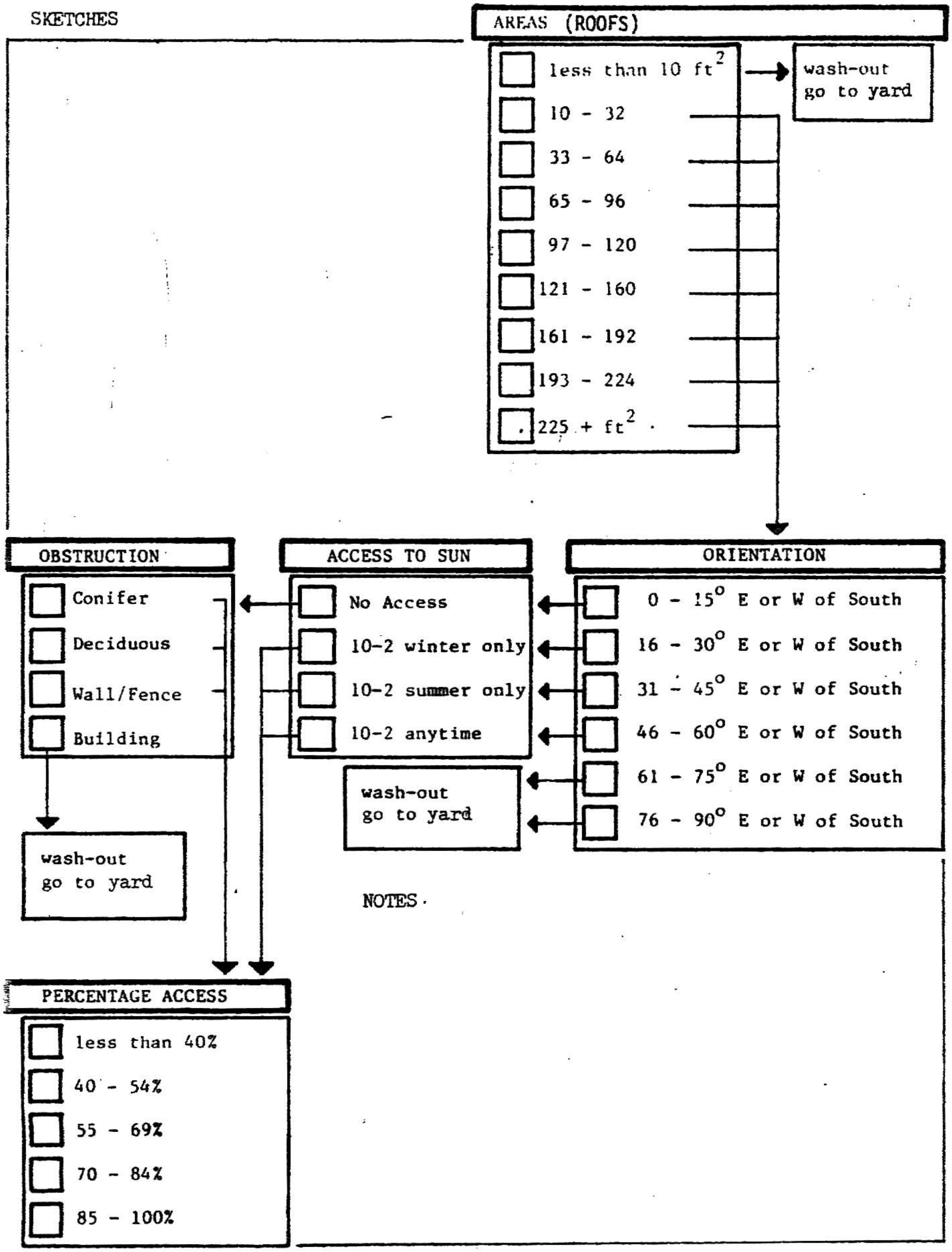
☐ ☐ ☐ ☐

Total Area of Rooms not used in winter ☐

NOTES

SOLAR SUITABILITY ASSESSMENT FOR ROOFS

INDICATE IN THE SPACE BELOW THE BEST ANSWER IN EACH SECTION, THEN FOLLOW THE ARROWS TO THE NEXT SECTION.



SKETCHES

AREAS (ROOFS)

- ☐ less than 10 ft^2 → wash-out go to yard
- ☐ 10 - 32
- ☐ 33 - 64
- ☐ 65 - 96
- ☐ 97 - 120
- ☐ 121 - 160
- ☐ 161 - 192
- ☐ 193 - 224
- ☐ 225 + ft^2

ORIENTATION

- ☐ 0 - 15° E or W of South
- ☐ 16 - 30° E or W of South
- ☐ 31 - 45° E or W of South
- ☐ 46 - 60° E or W of South
- ☐ 61 - 75° E or W of South
- ☐ 76 - 90° E or W of South

wash-out
go to yard

ACCESS TO SUN

- ☐ No Access
- ☐ 10-2 winter only
- ☐ 10-2 summer only
- ☐ 10-2 anytime

OBSTRUCTION

- ☐ Conifer
- ☐ Deciduous
- ☐ Wall/Fence
- ☐ Building

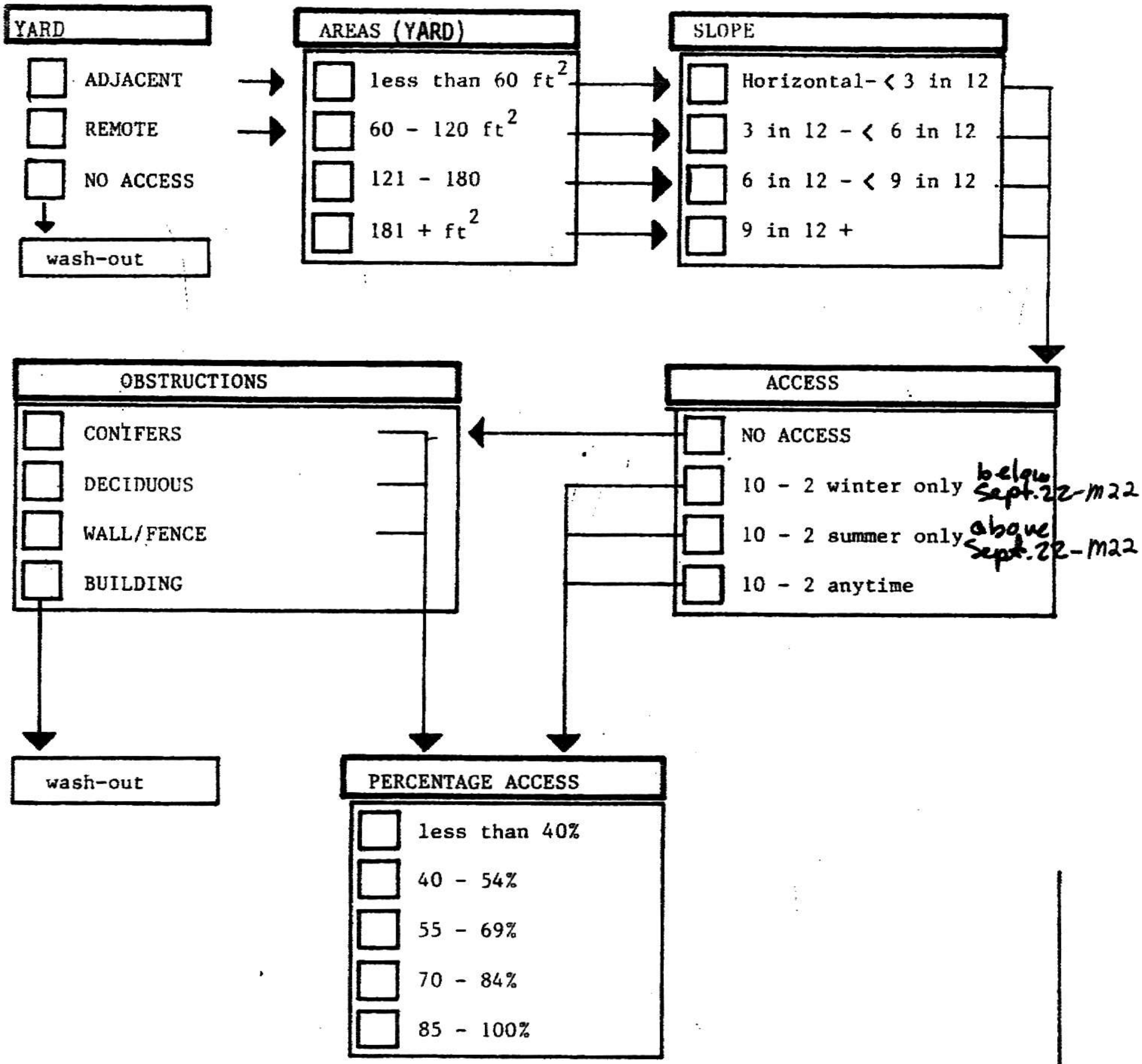
wash-out
go to yard

PERCENTAGE ACCESS

- ☐ less than 40%
- ☐ 40 - 54%
- ☐ 55 - 69%
- ☐ 70 - 84%
- ☐ 85 - 100%

NOTES.

SOLAR SUITABILITY ASSESSMENT FOR THE YARD



YARD

- ☐ ADJACENT
- ☐ REMOTE
- ☐ NO ACCESS

wash-out

AREAS (YARD)

- ☐ less than 60 ft^2
- ☐ 60 - 120 ft^2
- ☐ 121 - 180
- ☐ 181 + ft^2

SLOPE

- ☐ Horizontal- < 3 in 12
- ☐ 3 in 12 - < 6 in 12
- ☐ 6 in 12 - < 9 in 12
- ☐ 9 in 12 +

ACCESS

- ☐ NO ACCESS
- ☐ 10 - 2 winter only below Sept.22-M22
- ☐ 10 - 2 summer only above Sept.22-M22
- ☐ 10 - 2 anytime

OBSTRUCTIONS

- ☐ CONIFERS
- ☐ DECIDUOUS
- ☐ WALL/FENCE
- ☐ BUILDING

wash-out

PERCENTAGE ACCESS

- ☐ less than 40%
- ☐ 40 - 54%
- ☐ 55 - 69%
- ☐ 70 - 84%
- ☐ 85 - 100%

NOTES

RESIDENTIAL ENERGY AUDIT
INSTRUMENT #2

INTERVIEW ID ☐☐ DATE: October ☐☐

WHICH ONE ARE YOU? (MARK ONE) ☐ Head of Household

☐ Spouse

Through your response to these questions we would like to know how you truely feel about the statements provided. This is not a test. There are no right or wrong answers, and your responses will be kept entirely confidential.

INSTRUCTIONS: Mark with an 'X' the box which, by it's position on the scale, best represents your opinion.

1. To what degree would you be uncomfortable if you kept the temperature of you house at 68 degrees through the winter?

not uncomfortable ☐ ☐ ☐ ☐ ☐ ☐ ☐ very uncomfortable

2. Do you feel that your health and well being would be much better, much worse, or somewhere in between if you adjusted the temperature of your home to maintain 68 degrees throughout the winter?

much better ☐ ☐ ☐ ☐ ☐ ☐ ☐ much worse

3. To what degree would you say overconsumption by individuals has contributed to this country's energy problem?

very much ☐ ☐ ☐ ☐ ☐ ☐ ☐ not very much

4. To what degree do you think it possible that the cost of home fuel may rise to the point where you won't be able to afford it?

very possible ☐ ☐ ☐ ☐ ☐ ☐ ☐ not very possible

5. To what degree do you think it possible that, for whatever reason, your supply of heating fuel may be cut off in the near future?

very possible ☐ ☐ ☐ ☐ ☐ ☐ ☐ not very possible

6. How essential is it to your personal health and well being for the house to be airconditioned in the summer?

not very essential ☐ ☐ ☐ ☐ ☐ ☐ ☐ very essential

===

INSTRUCTIONS: Please indicate how strongly you agree or disagree with the following statements.

===

7. It's just not worth it to sweat some in the summer to save a little energy.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

8. I find it very difficult to fall asleep in the summer without an airconditioner on at night.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

9. While others might tolerate turning off the airconditioner in the summer, my own need for being cool is high.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

10. Turning off the airconditioner and opening the windows every time it gets a little cooler outside is just not worth the trouble.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

11. It is immoral to consume any more energy than I absolutely need.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

12. The energy crisis is largely due to real worldwide shortages of fuels needed to produce energy.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

13. The energy crisis is largely due to profiteering by those who control the world's energy resources.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

14. While others may be willing to set their thermostat lower in the winter, my own need for a very warm house is high.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

15. The energy crisis certainly doesn't warrant all the attention given to it in the last few years.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

16. American technology in the past has come to grips with all major crises and it will no doubt soon discover a solution to the energy problem.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

17. Consumers have the right to use as much energy as they want and can pay for.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

18. Trying to save a few pennies a day conserving energy is just not worth it.

strongly disagree ☐ ☐ ☐ ☐ ☐ ☐ ☐ strongly agree

==

19. Wintin these categories, could you tell me about what your combined family income (before taxes) was last year? (Responses will be kept entirely confidential)

- ☐ less than $5,000
- ☐ $5,000-$9,999
- ☐ $10,000-$14,999
- ☐ $15,000-$19,999
- ☐ $20,000-$24,999
- ☐ $25,000-$29,999
- ☐ $30,000 and above

20. What was the last level of formal education you completed?

- ☐ Never attended school
- ☐ Grade school
- ☐ Junior high school
- ☐ High school
- ☐ Vocational training
- ☐ College - Bachelor Degree
- ☐ College - Masters Degree
- ☐ College - Doctorate

TABLE 52

Residential Survey Sample Data - Gas Heated Residences

			Energy Demand			Space Heating		Sp. Cooling	
ID	Year Built	Area Heated Sq.Ft.	N. Gas MBTU	Elec MBTU	Total MBTU	Total MBTU	BTU/sq ft/HDD	Total MBTU	BTU/sq ft/CDD
1	1973	1300	114.8	24.2	139.0	95.0	13.3	3.1	2.6
2	1968	1352	147.3	73.4	220.7	82.3	11.07	13.8	11.6
3	1966	1350	173.7	30.1	203.9	120.4	16.22	7.2	6.0
4	1963	970	89.4	17.2	106.6	77.0	14.43	4.7	5.5
5	1967	2500	157.5	41.5	199.0	136.0	9.9	5.8	2.6
ave.		1454	136.5	37.3	173.8	102.1	12.98	6.9	5.6
6	1955	2178	125.0	28.2	153.2	86.4	7.21	6.2	3.2
7	1952	1154	110.7	36.9	147.6	76.0	12.13	9.5	9.3
8	1955	2160	157.5	26.5	183.9	120.9	10.18	8.2	4.3
9	1956	1123	89.4	17.2	106.6	64.0	10.36	1.4	1.4
10	1955	1188	107.6	8.5	111.1	75.4	11.55	.7	.7
11	1949	1024	100.6	21.5	121.9	68.6	12.18	4.1	4.6
ave.		1471	114.3	23.1	137.4	81.9	10.60	5.0	3.9
12	1921	2800	132.1	21.2	153.3	105.6	6.86	5.5	2.2
13	1920	528	93.5	17.5	111.0	58.7	20.21	1.6	3.5
14	1925	830	130.1	25.9	156.0	85.1	18.64	2.3	3.2
15	1920	900	143.3	18.0	161.3	114.1	23.05	1.6	1.9
16	1920	1220	115.8	24.5	140.4	87.6	13.06	1.5	1.4
17	1924	1206	129.0	24.3	153.4	83.1	12.53	4.2	3.9
18	1921	1800	128.0	21.9	150.0	86.9	8.78	.6	.4
19	1931	1091	167.6	24.1	191.8	133.8	22.31	5.5	5.7
ave.		1297	129.9	22.2	152.1	94.4	15.68	2.9	2.8
20	1905	1053	121.9	25.8	147.7	87.1	15.05	7.1	7.6
21	1918	2100	165.6	16.3	181.9	128.0	11.09	1.0	.5
22	1900	964	125.0	30.6	156.6	87.6	16.53	6.5	7.6
23	1900	985	168.6	22.8	191.4	121.9	22.51	8.5	9.8
24	1900	1025	149.4	26.8	175.6	117.3	20.82	4.7	5.2
25	1900	1388	139.2	24.7	163.9	83.8	10.98	4.5	3.5
26	1915	785	83.3	14.8	98.1	57.9	13.42	1.1	1.5
ave.	-	1186	136.3	23.1	159.3	97.6	15.77	4.8	5.1
27	1885	2150	220.5	22.5	243.0	179.8	15.21	2.4	1.3
28	1880	1909	121.9	29.8	151.7	94.7	9.02	-	-
29	1895	834	99.6	10.9	110.4	72.4	15.78	.4	.5
ave.		1631	147.3	21.1	168.4	115.6	13.34	.9	.6
Total Average		1370	131.1	25.1	156.2	96.1	13.94 (12.75)	4.3	3.8 (3.0)

TABLE 53

Residential Survey Sample Data, (Continued)

Dwelling Characteristics — Thermostat Setting

ID	Insulation		Storm	Storm	Caulk	Weath	Total	Daytime				Nighttime			
#	Attic	Wall	Wind.	Doors		Strip	Score	60	65	70	75	50	55	60	65
	R-38	R-11	All	All	recent	recent	24	64	69	74	79	54	59	64	69
1	2	4	4	4	4	2	20		x						
2	2	4	4	4	4	4	22		x						
3	2	4	4	0	0	0	10		x						
4	2	2	4	4	2	0	14			x					x
5	2	2	4	4	4	3	19		x					x	
av.	2														
6	2	4	3	2	3	2	16			x				x	
7	2	4	4	4	4	4	22			x					x
8	2	4	4	4	4	0	18			x				x	
9	2	1	4	4	0	0	11		x				x		
10	1	4	4	4	0	0	13	x					x		
11	2	4	4	4	0	2	16			x					x
av.	1.8	3.5	3.8	3.7	1.8	1.3	16								
12	2	4	4	0	2	2	14			x					x
13	3	0	4	4	1	0	12			x				x	
14	0	4	4	4	0	2	14			x					x
15	0	1	4	1	2	4	12		x					x	
16	2	4	4	4	3	3	20		x						
17	1	2	4	2	0	4	13			x				x	
18	4	4	4	3	4	4	23		x					x	
19	2	0	4	4	1	2	13		x					x	
av.	1.8	2.4	4	2.8	1.6	2.6	15								
20	2	2	4	4	2	4	18		x					x	
21	1	4	2	4	4	0	15			x					x
22	4	4	4	4	3	4	23		x						
23	1	1	4	4	0	0	10				x				
24	2	2	4	4	0	4	16			x					x
25	2	4	4	4	0	0	14		x			x			
26	2	4	2	4	0	1	11			x		x			
av.	2	3	3.4	3.7	1.3	1.9	15								
27	3	0	4	4	3	2	16		x				x		
28	0	0	4	4	4	4	16		x				x		
29	2	0	3	4	3	0	12			x				x	
av.	1.7	0	3.7	4	3.3	2	10								
Total Av.	2	2.8	3.8	3.5	2.1	2.0	15.9								

TABLE 54

Residential Survey Data (Continued)

Solar Suitability Potential

	For Space Heating Roof and Wall Area			For Water Heating Only Roof Area Only		
ID	High	Med	Low	High	Med	Low
1	X			X		
2	X			X		
3	X			X		
4		X		X		
5		X			X	
6	X			X		
7	X			X		
8		X			X	
9	X			X		
10			X			X
11		X				X
12	X			X		
13	X			X		
14			X			X
15	X			X		
16	X			X		
17	X			X		
18	X			X		
19	X			X		
20	X			X		
21			X			X
22	X			X		
23	X			X		
24	X			X		
25			X			X
26		X		X		
27	X			X		
28	X			X		
29	X			X		
30		X				X
Total	19	7	4	22	2	6
%	63.3	23.3	13.3	73.3	6.7	20

The following procedure was used to estimate the solar potential for water heating;

```
if v_166 = 6, 7, 8, or 9 then do
if v_167 = 1 then
if v_168 = 4 then
if v_170 = 3, 4, or 5  then   Label = High Solar Water Heating/
                                      High Roof Area, Some Shading

if v_166 = 4 or 5 then
if v_167 = 1 then
if v_168 = 4 then
if v_170 = 5 then   Label = High Solar Water Heating/
                            Medium Roof Area, No Shading

if v_166 = 8 or 9 then
if v_167 = 1 then
if v_168 = 4 then
if v_170 = 1 or 2  then  Label = Medium Solar Water Heating/
                                 Small Roof Area, No Shading

Label all others = Low Water Heating
```

The following procedure was used for determining solar space heating potential:

```
if v_159 = 7 or 8 or 9 then
if v_160 = 1 then
if v_161 = 2 or 4 then
if v_163 = 4 or 5 then
if v_166 = 7 or 8 or 9 then
if v_167 = 1 then
if v_168 = 2 or 4 then
if v_170 = 4 or 5  then Label = High Space Heating/ High Wall, High Roo

if v_159 = 7 or 8 or 9 then
if v_160 = 1 then
if v_161 = 2 or 4 then
if v_163 = 5 then
if v_166 = 4 or 5 or 6 then
if v_168 = 2 or 4 then
if v_170 = 5 then Label = High Solar Space Heat/ High Wall, Medium Roof

if v_159 = 4 or 5 or 6 then
if v_160 = 1 then
if v_161 = 2 or 4 then
if v_163 = 5 then
if v_166 = 7 or 8 or 9 then
if v_168 = 2 or 4 then
if v_170 = 5 then Label = High Solar Space Heat/Medium Wall, High Roof

if V_159 = 4, 5, or 6 then
if V_160 = 1 then
if V_161 = 2 or 4 then
if V_163 = 4 or 5 then
if V_166 = 4 or 5 or 6 then
if V_167 = 1 then
```

```
if V_168 = 2 or 4 then
if V_170 = 4 or 5 then label= Medium Solar Space Heat/
                              Medium Wall, Medium Roof

if v_159 = 7 or 8 or 9 then
if v_160 = 1 then
if v_161 = 2 or 4 then
if v_163 = 3 or 4 or 5 then
if v_166 = 1 or 2 or 3 then
if v_167 = 1  then
if v_168 = 2 or 4 then
if v_170 = 4or 5 then Label = Medium Solar Space Heat/
                               High Wall, Low Roof

if v_159 = 1 or 2 or 3 then
if v_160 = 1 then
if v_163 = 4 or 5 then
if v_166 = 7 or 8 or 9 then
if v_167 = 1 then
if v_168 = 2 or 4 then
if v_170 = 3 or 4 or 5 then Label = Medium Solar Space Heat/
                                    Low Wall, High Roof
```

Appendix C

MARYSVILLE MERCHANTS ATTITUDE SURVEY

Merchants Attitude Analysis
Marysville, Kansas

December, 1982

Prepared By:

Kansas Department of Economic Development
John Carlin, Governor
Charles J. Schwartz, Secretary

Planning and Community Development Division
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VI. ENERGY

ENERGY

As energy costs continue to rise, the impact on small businesses becomes a major factor in their ability to maintain a reasonable profit margin. With the assistance of a design class of the KSU College of Architecture and Design, a number of altitudinal and demographic energy related questions were developed. These questions were included on the survey form to gauge the impact and attitudes of Marysville business people regarding energy and its costs.

Business people were asked if the increased cost of energy affects the way they operate their businesses. Fifty-six percent of the respondents indicated that it has, 35.4% said it has not, and 8% of the business people did not know. When asked if they thought energy will continue to rise in price, 91.2% feel it will, 7.1% have no opinion, and only 1.8% feel it will not rise in price. Respondents were given an opportunity to add additional comments and those responses are included in the appendix on page 31.

Temperature is a consideration when determining the shopping comfort of a retail downtown area. To gauge the perception of business people regarding thermal comfort, respondents were asked of what importance temperature and wind are on attracting customers to shop downtown. Twenty-six percent feel it is important, 54.9% feel it is of some importance and influences shopping behavior, and only 18.6% feel it has no importance.

Almost a majority (48.6%) of the business people indicated they have no plans to reduce their energy costs in the next year, 39% do have an energy plan for the coming year, and 12.4% did not know. Respondents were given an opportunity to add additional comments and those responses are included in the appendix on page 32. Finally, respondents were asked if they would be interested in forming a cooperative with other businesses to reduce the total and individual costs of energy related improvements. Forty percent of the business people are interested in forming a cooperative arrangement, 24.3% are not interested, and 35.9% have no opinion.

Business people were asked a number of questions regarding their heating and cooling system. Gas is the primary fuel utilized by Marysville businesses to heat space and water for their structures. Eighty-seven percent of respondents use gas for heating either water or space, and 60.6% use gas for both their water and space heating needs. Electricity, while not as popular among business people, was used by 21.3% of the respondents. Propane, oil, wood and other fuels received very limited usage in water and space heating needs. It should be noted that 85.9% of respondents pay for their heating fuel bills.

A large majority (91%) of businesses responding air condition their business places. Central air conditioning units were most popular and are utilized by 66% of the businesses in Marysville. Nine percent of businesses do not air condition their buildings, and 25% use room air conditioners. Sixty-three percent of businesses utilizing room air conditioners operate one unit, 26.3% have two units, and 10.5% use more than two units. It should be noted that 89.2% of respondents pay for their electrical bills.

SUMMARY OF ENERGY ATTITUDES

* Fifty-six percent of business people indicated the increased cost of energy has affected their business operations.
* Over ninety-one percent (91.2%) feel energy costs will continue to rise.
* Over eighty percent (80.9%) feel thermal comfort has at least some importance in attracting customers to shop downtown.
* Thirty-nine percent have some plan to reduce energy costs in the coming year.
* Forty percent are interested in forming a cooperative with others to reduce energy costs.
* Natural gas is the predominate fuel for heating businesses in Marysville.
* Central air conditioning is present in over 90% of the respondents businesses in Marysville.
* Over eighty-five percent (85.9%) of the respondents pay for their heating fuel bills and 89.2% of respondents pay for their electrical bills.

1. How many years has your establishment been in business?

Less than 1 year	7		
1-2 years	8	9-10 years	3
3-4 years	2	11-15 years	7
5-6 years	10	16-20 years	16
7-8 years	2	Over 20 years	62

2. How many years has your establishment been in business at its present location?

Less than 1 year	11		
1-2 years	8	9-10 years	5
3-4 years	9	11-15 years	5
5-6 years	14	16-20 years	17
7-8 years	7	Over 20 years	41

3. Which of the following best describes your establishment?

Own structure and property	69	Rent structure and property	17
Lease structure and property	11	Rent office space	15
Lease purchase structure and property	3	Other	0
		No Response	2

Do you pay the bills for: Heating Fuel? YES 94 NO 16 NR 7

Electricity? YES 99 NO 12 NR 6

4. If you do not own the building, is the owner a local resident?

YES 37 NO 10

5. Designate how each floor in your building is *primarily* used. (Check only one blank on each floor.)

BASEMENT FLOOR		FIRST FLOOR		UPPER FLOOR(S)	
Storage	28	Storage	1	Storage	9
Retail	7	Retail	53	Retail	2
Residential	0	Residential	3	Residential	8
Office	13	Office	35	Office	3
Vacant	7	Vacant	0	Vacant	14
Shop	4	Shop	18	Shop	0
No Response	58	No Response	7	No Response	81

6. Is the structure in which you are located of adequate *size* to house your business activities?

YES 102 NO 13 NO OPINION 1 NO RESPONSE 1

7. Is the structure in which you are located in adequate *condition* for your business operations?

YES 106 NO 7 NO OPINION 3 NO RESPONSE 1

8. Do you plan any improvements to your structure in the near future?

YES 35 If yes, what type? Exterior 13 Exterior & Interior 9

NO 79 Interior 12

NO RESPONSE 3 NO RESPONSE 83

9. What are your business hours?

OPEN AT		CLOSED AT	
7 a.m. or earlier	10	Before 5 p.m.	6
8 a.m.	26	5 p.m.	27
9 a.m.	23	6 p.m.	9
Later than 9 a.m.	9	After 6 p.m.	20
NO RESPONSE	49	NO RESPONSE	55

	OPEN	CLOSED	NO RESPONSE
Monday Evenings	22	85	10
Thursday Evenings	35	72	10
Lunch Hours	69	35	13

What are your Saturday business hours?

OPEN AT		CLOSED AT	
Before 8 a.m.	9	Noon	21
8 a.m.	15	1 p.m. or 2 p.m.	3
9 a.m.	18	4 p.m.	2
After 9 a.m.	10	5 p.m.	4
Not Open	7	6 p.m.	4
NO RESPONSE	58	After 6 p.m.	19
		Not Open	7
		NO RESPONSE	57

Are you open on Sunday? YES 20 NO 97

10. Indicate the number of full time equivalent employees employed at your business?

NUMBER OF EMPLOYEES	NUMBER OF RESPONSES
1	35
2	20
3	12
4	8
5	7
6	2
7	2
8	1
9 or more	8
No Response	22

11. FOOD STORES OR RESTAURANTS -- Do you now carry or use local (Marshall or surrounding counties) produce? YES 15 NO 9

If not, would you consider it if reasonably priced?

YES 6 NO 3 NO OPINION 2

12. Would you support a cooperative advertising program to promote the area merchants and the community?

YES 44 NO 19 NO OPINION 34 NO RESPONSE 20

13. Are you a member of the Marysville Chamber of Commerce?

YES 71 NO 36 NO RESPONSE 10

If not, what are your reasons?

- Chamber is too self centered on Broadway only, not to promote greater Marysville in general.
- Conflict in goals: downtown vs. ag implement dealers.
- The Chamber is geared for retail business on Broadway.
- Too busy to be a member.
- Chamber of Commerce leaves too much to be desired.
- The Chamber never came around to ask for my dues.

14. Would you participate in a Chamber supported shoppers survey?

YES 53 NO 12 NO OPINION 37 NO RESPONSE 15

15. Do you participate in the following special events?

	YES	NO	NO RESPONSE
January Clearance Sale	20	77	20
President's Sale	17	81	19
Easter Promotion	27	74	16
Pony Express Days	30	70	17
Father's Day	22	74	21
4th of July Promotion	24	74	19
July Sidewalk Sale	34	65	18
Back to School	25	72	20
Fall Opening	23	76	18
Black Squirrel's Day	31	69	17
Christmas Opening	33	67	17
Christmas Season	42	59	16

16. Are there other special events you would like to see incorporated into Marysville promotional events?

YES 9 NO 30 NO OPINION 62 NO RESPONSE 16

If yes, please indicate suggestions:

- I think the Chamber of Commerce is making a real good effort in their promotional events during the year.
- Chamber needs to involve others in Chamber promotions - if nothing else for planning purposes.
- Mothers Day
- Youth activities during school vacations.
- I would like to see the money spent on a model community, which is apparently a waste, because things are worse than ever, be used for a YMCA type entertainment center.
- Since the community is dependent on agriculture, I think more farm-city activities need to be developed than the farm-city night.
- Auto shows
- Implement shows

17. How would you rate the following community services?

	Excellent	Good	Adequate	Fair	Poor	No Opinion	No Response
Police Protection	10	36	42	13	7	3	6
Fire Protection	25	55	23	4	3	3	4
Maintenance of Public Spaces	8	35	40	18	3	5	8
Trash Pick-Up	27	58	14	5	1	4	8
Water	10	28	29	19	25	0	6
Sewer	10	51	39	7	2	2	6
Electric Power	18	63	22	5	2	1	6
Natural Gas	20	62	21	3	1	2	8
Telephone	16	37	35	17	5	1	6
Chamber of Commerce	9	37	33	14	7	11	6

18. With regard to conducting your business, do you consider the overall appearance of the central business district to be:

33 very important
56 important
12 of little importance
6 has no influence
5 no opinion
5 no response

19. How would you rank the appearance of your downtown compared to surrounding communities?

7 excellent
49 good
51 average
2 worse
2 much worse
3 no opinion
3 no response

20. Would you support the continued renovation of downtown Marysville as it has been developed on the Koester Block? (Lighting, brick sidewalks, trees, store front improvements.)

YES 48 NO 34 NO OPINION 27 NO RESPONSE 8

- Downtown brick streets are extremely rough - should be improved.
- At a time when economy is such that to do so would not bankrupt and permanently close the doors of the merchants presently there.
- Yes, but not to force all businesses to conform - currently too expensive.
- Begin again when things are better economically.
- It should be up to each business and owner.
- As long as feasible. Don't overspend.
- The renovation would give uniform look. The trees would add some color which is needed and break up the angular store look.
- The renovation of our downtown is good, but should in no way be a limiting factor in any business expansion.
- Appearance is good, but empty businesses need to be filled.
- Lighting yes, but only if the city picks up part of the tab - no bricks.
- I don't think brick sidewalks and trees make a business.
- It has been good improvement on downtown, though we are outside city limits.
- Lighting and store front improvements - yes.

20. Would you support the continued renovation of downtown Marysville as it has been developed on the Koester Block? (Lighting, brick sidewalks, trees, store front improvements.) CONTINUED

- I am for it, but since it does not cost me anything makes quite a difference.
- Store fronts and in-store improvements should be primary.
- Because all the work would be along Broadway nothing is being done for merchants on Center.
- Trees are not going to bring business.
- Benefit not worth the cost.
- Get rid of those darn slick, worthless brick.
- Already pay taxes for street lighting, why should it also buy the street.
- Not until our main streets are cleaned on a day-to-day basis.
- Need a way of keeping young people employed.
- I am having a bad enough time supporting myself at this point and time.
- When you consider renovation, I think you must consider if the business paying the cash can actually afford the expense and if new business will off set it.
- Not unless the residents, and not businesses, pay for the development - we don't need another tax for being in business in Marysville.
- I can not see putting that much money into putting a man in business (Koester Block).
- Lighting is good - but city should get involved and pay for installing.

21. Do you think that downtown needs a certain type(s) of new business?

YES 57 NO 12 NO OPINION 40 NO RESPONSE 8

If yes, what types?:

- Good steak with club
- (3) Variety store
- Retail clothing
- Any type of business as empty buildings do not make good appearance
- A building material supplier that is interested in researching and stocking energy saving supplies and educating the potential purchaser of the advantages of the products.
- (3) Dime store
- (3) Any retail
- Men's clothing
- New industries
- Grocery
- Anything
- (2) Health store - diet center
- A great deal of downtown space is going to office use, this may hurt retail base.
- Health care - pet store - book store
- (2) Better restaurant
- Warehouse food store
- Fast food restaurant
- Anything that can make it in these times

21. Do you think that downtown needs a certain type(s) of new businesses? CONTINUED

- Entertainment center
- Eating establishment - thank goodness for the Koester House - prior to the opening it was an embarrassment to have out of town business associates to join you for lunch
- Not necessarily new businesses but we do need to at least fill the "vacant" spots
- A city health center or gym would be great
- Medium priced children's clothes
- Men's and boys store
- Bicycle shop - motor bike

22. What do you think are the biggest problems downtown?

Cleanliness/Appearance

- Owners indifference to the appearance of their own stores.

Buildings

- (6) Empty stores
- All businesses working together fixing up buildings
- Need to refurbish old store fronts.
- Like to see continued improvement in store fronts.
- Vacant buildings - when you have vacant buildings it gives the appearance the town is dying.
- Penney's won't remodel
- Building west of Pony Express needs improvements.

Traffic

- Location of railroad and highways
- Railroad holding up traffic

Streetscape

- (4) No public restrooms

Parking

- Employees taking up parking spaces
- (17) Parking
- At times the parking is a problem
- Business people taking up parking spaces
- (3) Employees parking downtown
- Lack of off street parking for employees

Retailing

- Lack of aggressive marketing
- Lack of retail outlets
- Prices too high
- (2) Difficult for small merchants to compete with chain stores
- Not enough business
- Lack of aggressive merchants
- Need more space for new businesses
- Walmart
- I feel some merchants do not specialize in their type of business - they want to overlap in other areas instead of promoting items they are "supposed" to handle

22. What do you think are the biggest problems downtown? CONTINUED

Attitude

- Lack aggressiveness - poor attitudes. More attention should be paid to customer needs rather than so much about the aesthetics.
- (4) Lack cooperation
- Public attitude
- Lack of friendly, courteous, attentive owners, managers, and clerks. Lack of pride in exterior and interior buildings.
- Lack of competitiveness. I have the feeling from many that they often do not care if I or anyone else does business or not.
- A "make do" minimal expense attitude "hope things get better, but I don't want to spend anything to help."
- (2) Attitude of merchants
- Lack of coordination in efforts to promote Marysville as a total shopping place
- Jealousy between merchants
- (2) Too many people trying to run other peoples business and spending their money
- Poor attitude of retail merchants over the years has set a feeling of distaste in the local populace due to high prices and snobbish attitude. Long term problems, now they want a short term solution.

Streets

- Inadequate drainage and main street in need of immediate repair.
- Street up keep
- Dirty streets
- (9) Brick streets

Miscellaneous

- Some services duplicated to the non-profit point. Inability of downtown to accept the fact that other off Broadway/Center businesses are part of the community backbone. A need to promote the community as a whole.
- None
- Present economic condition
- (2) Kids from 10-50 drinking
- Too many years of "taking" and "giving little" in return
- (3) The economy
- Kids on bikes
- Too many places to purchase beer - too easy to get
- The only part of Marysville that is promoted is the merchants on Broadway. If they would clean up Center street downtown Marysville would be better. Walmart has about put everybody out of business.
- Poor conditions for handicapped
- Need more things for young and retired people to do.
- The street is full of kids with nothing to do.

22. What do you think are the biggest problems downtown? CONTINUED

Miscellaneous - Continued

- Failure of our court system to act, city administration adds to confusion.
- City council
- Chamber of Commerce
- Rent on most buildings are too high so small businesses can not afford to rent

23. What do you think are downtown's assets?

Cleanliness/Appearance

- Businesses are clean and kept up
- (4) Attractive
- (5) Compact area

Buildings

- Age of buildings - old type could be a drawing card

Traffic

- Highways

Streetscape

- We have a picturesque historical setting

Parking

- Free parking - compact area and fair assortment of stores
- Adequate parking

Retailing

- (3) Well established business
- Good stores, banks, and cafes
- The established businesses
- Dependable merchants
- Variety
- A few younger retailers show some spark
- Good variety of stores
- Business that is located downtown

Attitude

- The good will of the merchants
- Relatively compact - friendly - attitude of business people
- Publics investment in the area
- (3) Merchants are friendly
- (5) Friendly people

Streets

- Paved streets
- Brick streets - no parking meters
- Wide streets

23. What do you think are downtown's assets? CONTINUED

Miscellaneous

- OK
- Willing and skilled workers with desire but need help going. Excellent selection of goods and services. Easy to get around central business area.
- (2) Location, history, two major highways through town
- Central location
- A few good merchants and a few good buildings
- (3) Unique agriculture market location. One of the few towns in the mid west to have all the major agri dealers in the same town - drawing from distances way out of proportion to size
- (3) Historic background
- Too many to list
- Marysville has a lot to offer. Have had lots of tourists just walk the streets - they enjoy just looking, and many times I am sure they make purchases.

24. Indicate the type of fuel you use for heating your building and water.

	Heating Space	Heating Water	Both	Not Applicable	No Response
Natural Gas	27	4	71	6	9
Electricity	9	9	7	21	71
Propane	2	1	1	28	85
Oil	3	0	1	29	84
Wood	4	0	0	29	84
Other	4	1	0	29	83

25. What type of air conditioning do you have?

10	None	1 unit	24
26	Room (How many units?)	2 units	10
74	Central	3 units	3
2	Heat Pump	8 units	1
5	No Response		

26. Please indicate the importance of outdoor thermal (temperature, wind, etc.) comfort of pedestrians in attracting customers to shop downtown?

24 Important
56 Of some importance, but does influence shopping behavior
19 No importance
15 No response

27. Has the increased cost of energy affected the way you run your business?

YES 64 NO 40 NO OPINION 9 NO RESPONSE 4

28. Do you think the cost of energy will continue to rise in price?

YES 103 NO 2 NO OPINION 8 NO RESPONSE 4

28. Do you think the cost of energy will continue to rise in price? Why? CONTINUED

- Yes
- (2) Limited resource
- Energy in its present form is a depletable substance.
- Because of factors of bookkeeping - the more the utility spends the higher the rates. Utilities have found they can get rates increased very easily without public backlash.
- How else will the oil companies continue to make large profits.
- Democrats
- D.O.E. is operating in reverse
- Utility companies are monopoly's and will gouge whenever possible.
- The price of gas and electricity has always gone up.
- Dwindling oil supplies and increased production costs. Deregulation - inflation
- A continued strong demand with more luxuries using energy every year.
- Utilities have the only game in town
- Inflation, decontrol, and natural gas
- Because of the cost, people are turning to different ways (so cost goes up to the rest who are using it).
- (3) Deregulation
- (3) Big companies
- Obvious that oil products will rise.
- People want more ways and we have to pay for energy improvements.
- No competition
- All they have to do is ask
- (2) It always has
- Scarcity of resources
- Utilities are greedy
- Its built into the system - the more we conserve the more we pay
- Higher level of use, general inflation and depletion of fossil fuels
- (2) Government policies. Profit gouging energy companies.
- Oil companies are contolling the government and country.
- Probably
- Can not if natural gas increases
- Natural gas price contracts
- Imports and deregulation
- Inflation
- Republicans
- Higher wages
- Big business

29. Do you have any plans to reduce your energy cost during the next year?

YES 41 NO 51 NO OPINION 13 NO RESPONSE 12

If so, what do you plan to do?

- Reduce number of trips, car pool, and use telephone
- Insulation, more efficient equipment, better scheduling
- Weather stripping around doors and windows
- Already using as little as possible.
- Continue to pay bills so will be aware of cost
- Burn wood
- (2) Better insulation

29. Do you have any plans to reduce your energy cost during the next year? If so, what do you plan to do? CONTINUED

- Try to get my compressors on demand meter so they don't all start up at once
- Open to suggestions
- Maybe in a year or so change out large front windows to the south
- New boiler - new storm windows
- Use less lighting - turn down thermostat
- Waste oil heater
- Whatever can be done
- We are remodeling future building to occupy in 1983 - putting in R-11 insulation, heat pump
- Install fans
- We just completed a new office building and considered energy cost in the construction
- Pray
- Close front windows
- Maybe try to get along without air conditioners on marginal days. Same way with heat.

30. How interested would you be in forming a cooperative with other businesses to reduce the total (and individual) costs of energy related improvements?

9 very interested
32 interested
25 not interested
37 no opinion
14 no response

GENERAL

31. Express your personal feelings and ideas on improvements for Marysville.

- More retail businesses downtown with more promotions.
- In towns the size of Marysville business is slow especially the real estate business which is picking up now, due to lower interest rates and I feel this will help many businesses that are hurting now.
- Things are going to happen - how well depends on how well we plan
- Marysville attitude must change from one of "everything is wrong" (negative) to "we can do" (positive), we should learn from the past but not live in the past. We should accentuate the position in our conversation and print. We should actively pursue industry and business.
- We need the input of the community as a whole on what is needed/ wanted. The business community must set aside the dog eat dog feelings and to set down together long enough to get headed in one general direction on major projects. Many marginal services need not be duplicated. We must think of the Marshall County area as a common community and try to promote and sell on that basis. We need banks that are willing to invest heavy in the county instead of bonds, etc.

31. Express your personal feelings and ideas on improvements for Marysville.
CONTINUED

- Vote Democrats out of Washington, D.C. and Topeka - exercise fiscal restraint and prosperity will return
- No drastic changes - improvements to be made as money is available
- Get the Union Pacific to finish their park. If they don't want to plant grass, they should make it a parking lot.
- Work together
- Need downtown development bad. (Need to develop area vacated by Hotel Pacific.)
- Need to develop better attitude
- I think Marysville is a good town and for improvements, each business should keep striving to improve themselves.
- This survey is a waste of tax payers time and money.
- Businesses that have back entrances on Center Street need to do something to improve the looks of the back of the buildings. It certainly does not make a good impression to travelers.
- Small businesses need to become more service oriented to compete.
- Work together instead of trying to shove ideas down others throats, which will not be practical in this community. Repairs to building and clean up Center Street. I realize brick streets are nice, but if they want to keep them - fix them. If possible replace our downtown lighting with something more attractive. If nothing else, paint the poles and arms.
- Bring in some new industries instead of trying to keep them away. Install concrete and asphalt instead of those costly brick they are slick, expensive up keep, rough. If the Chamber, PRIDE Committee, and others are going to push advertising lets do it on an even basis.
- Need area wide industrial development push to attract new industry to Marshall County. New housing developments in North Park. Remove brick, level base and relay bricks. Monthly promotions of businesses together. Pony Express Barn and Koester House Museum should be open summer time from 7:30 a.m. to 8:30 p.m. seven days a week.
- Some innovative credit programs by local banks. Local purchasing whenever possible.
- (2) Continue downtown renovation.
- I am happy with Marysville at the present time. We need to continually try to improve our educational system. Also work to give young people a variety of worthwhile alternatives.
- I have been impressed with Marysville since I first came here a year ago. As rural town - this community has done very well compared to most. I believe strongly that we need to "sell" our town companies - capable of bringing jobs to the area.
- Need nicer restaurants. Fill up empty buildings. Need to push for new companies to come into area to stimulate interest in young people to stay.
- We need some overnight camping areas. Our city park is a disaster.
- Marysville needs something to get things started
- More industry

31. Express your personal feelings and ideas on improvements for Marysville.
CONTINUED

- Find parking area for business people so wouldn't take up shopping spaces
- New industry
- Utility lines underground
- Paint crosswalk and parking stalls
- Many improvements have been made in overall appearance of Marysville - flowers, trees
- You cannot bring business in on looks - merchants have to offer service and be willing to help customers - trees, bricks, and lights don't cut it.
- There appears to be too many factions trying to improve Marysville - there needs to be one central body to coordinate or oversee the activity
- Need two new city trucks and improved fire department training
- Union Pacific Park needs to be completed
- Need activities for the kids
- If they would worry about the whole town and not just the Koester Block things might get done.
- I feel the main thing is to improve the image and outlook on the buildings and surroundings
- Soon Marysville will have a general improvement plan now being finalized. Considerable study has gone into this project and it will provide the blueprint for future development.
- Each merchant can improve the looks of their business - inside and out.
- There are a few who are trying to cram this down our throats. We don't need it. We can't afford it and it is not necessary.
- Too many people talking and not wanting to work with others.
- Mayor and city council very bad - bad on the town.
- Chamber needs to be striving to draw industry into the area. Labor costs are low as well as other overhead expenses. The railroad would also be an asset to industry.

Appendix D

MARYSVILLE YEAR 2002 AGE/SEX PYRAMID

POPULATION PYRAMID FOR THE YEAR 19~~70~~80

```
                               *  =    10 PEOPLE
                               MARYSVILLE KANSAS
AGE     NUMBER                      MALES     ^      FEMALES                   AGE         NUMBER
85+         43                           **** ^ **********                     85+             98
80-84       43                           **** ^ **********                     80-84           98
75-79       44                           **** ^ **********                     75-79           99
70-74       97                     ********** ^ **************                 70-74          137
65-69       83                       ******** ^ **************                 65-69          141
60-64      100                     ********** ^ ************                   60-64          120
55-59       94                      ********* ^ ***********                    55-59          114
50-54       92                      ********* ^ *********                      50-54           87
45-49       62                         ****** ^ ********                       45-49           81
40-44       68                        ******* ^ ********                       40-44           80
35-39       69                        ******* ^ ********                       35-39           77
30-34      130                  ************* ^ ***********                    30-34          108
25-29      128                  ************* ^ **************                 25-29          139
20-24      133                  ************* ^ **************                 20-24          141
15-19      125                  ************* ^ **************                 15-19          136
10-14      109                    *********** ^ ************                   10-14          123
 5- 9      118                   ************ ^ *********                       5- 9           89
 0- 4      136                 ************** ^ *************                   0- 4          128
SUM:      1674 ^----^----^----^----^----^----^ ^----^----^----^----^----^----^ SUM:          1996
               300       200       100       0          100       200       300
                              TOTAL POPULATION:         3670

                          POPULATION PYRAMID BY PERCENTAGE
                                      * = .2 PERCENT
AGE    PERCENT                      MALES     ^      FEMALES                   AGE         PERCNT
85+        1.2                         ****** ^ *************                  85+            2.7
80-84      1.2                         ****** ^ *************                  80-84          2.7
75-79      1.2                         ****** ^ *************                  75-79          2.7
70-74      2.6                  ************* ^ *******************            70-74          3.7
65-69      2.3                    *********** ^ *******************            65-69          3.8
60-64      2.7                 ************** ^ ****************               60-64          3.3
55-59      2.6                  ************* ^ ****************               55-59          3.1
50-54      2.5                  ************* ^ ************                   50-54          2.4
45-49      1.7                       ******** ^ ***********                    45-49          2.2
40-44      1.9                      ********* ^ ***********                    40-44          2.2
35-39      1.9                      ********* ^ **********                     35-39          2.1
30-34      3.5             ****************** ^ ***************                30-34          2.9
25-29      3.5              ***************** ^ *******************            25-29          3.8
20-24      3.6             ****************** ^ *******************            20-24          3.8
15-19      3.4              ***************** ^ *******************            15-19          3.7
10-14      3.0                *************** ^ *****************              10-14          3.4
 5- 9      3.2               **************** ^ ************                    5- 9          2.4
 0- 4      3.7            ******************* ^ *****************               0- 4          3.5
               ^----^----^----^----^----^----^ ^----^----^----^----^----^----^
               6         4         2         0           2         4         6
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                              POPULATION PYRAMID FOR THE YEAR
                                     *  =    10 PEOPLE
                                     MARYSVILLE KANSAS

AGE      NUMBER                      MALES  ^           FEMALES              AGE      NUMBER
85+          32                          *** ^ ************                   85+          118
80-84        41                         **** ^ **********                     80-84        100
75-79        44                         **** ^ **********                     75-79         98
70-74        62                       ****** ^ *********                      70-74         91
65-69        50                        ***** ^ *********                      65-69         92
60-64        59                       ****** ^ *********                      60-64         87
55-59        63                       ****** ^ ********                       55-59         77
50-54       126                ************* ^ ***********                    50-54        107
45-49       162             **************** ^ ***************                45-49        148
40-44       192          ******************* ^ ****************               40-44        159
35-39       179           ****************** ^ ****************               35-39        157
30-34       144               ************** ^ **************                 30-34        139
25-29       121                 ************ ^ **********                     25-29         98
20-24       128                ************* ^ ***************                20-24        147
15-19       150              *************** ^ *****************              15-19        171
10-14       141               ************** ^ ***************                10-14        151
 5- 9       140               ************** ^ **************                  5- 9        141
 0- 4       130                ************* ^ *************                   0- 4        127
SUM:       1964^----^----^----^----^----^----^ ^----^----^----^----^----^----^SUM:       2208
               300       200       100       0        100       200       300
                          TOTAL POPULATION:           4172


                              POPULATION PYRAMID BY PERCENTAGE
                                     *  =  .2 PERCENT
AGE    PERCENT                       MALES  ^           FEMALES                AGE  PERCNT
85+        0.8                          **** ^ **************                 85+         2.8
80-84      1.0                         ***** ^ ************                   80-84       2.4
75-79      1.1                         ***** ^ ************                   75-79       2.3
70-74      1.5                       ******* ^ ***********                    70-74       2.2
65-69      1.2                        ****** ^ ***********                    65-69       2.2
60-64      1.4                       ******* ^ **********                     60-64       2.1
55-59      1.5                      ******** ^ *********                      55-59       1.8
50-54      3.0               *************** ^ *************                  50-54       2.6
45-49      3.9           ******************* ^ ******************             45-49       3.5
40-44      4.6       *********************** ^ *******************            40-44       3.8
35-39      4.3         ********************* ^ *******************            35-39       3.8
30-34      3.5             ***************** ^ *****************              30-34       3.3
25-29      2.9               *************** ^ ************                   25-29       2.3
20-24      3.1               *************** ^ ******************             20-24       3.5
15-19      3.6            ****************** ^ ********************           15-19       4.1
10-14      3.4             ***************** ^ ******************             10-14       3.6
 5- 9      3.4             ***************** ^ *****************               5- 9       3.4
 0- 4      3.1              **************** ^ ***************                 0- 4       3.0
               ^----^----^----^----^----^----^ ^----^----^----^----^----^----^
              16        4         2         0         2         4         6
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Appendix E

SUGGESTED STRATEGIES FOR COMMUNITY ENERGY MANAGEMENT

Strategies for Energy Management in Energy Resources

		Character and Focus of Strategy					Strategy Energy Impact Area			
		Mandatory	Incentive	Educational	New Construction	Existing Construction	Municipal	Residential	Commercial/ Industrial	Transportation
Option	Strategy									
Increased use of Solar, Wood, Wind, Hydro-power, and Solid Waste	Low interest loans		X		X	X		X	X	
	Grants to low-income households		X		X	X		X		
	Real property tax credits		X			X		X	X	
	Favorable utility rate structures		X		X	X	X	X	X	
	Real property tax abatements		X		X	X		X	X	
	Sales tax credit/exemptions		X		X	X		X	X	
	Zoning ordinance		X		X		X	X	X	
	Real property tax exemptions		X					X	X	
	Advertising campaigns			X	X	X	X	X	X	
	Information services			X	X	X	X	X	X	
	Individual building consultation		X	X		X	X	X	X	

Strategies for Energy Management in Community Design

		Character and Focus of Strategy					Strategy Energy Impact Area			
		Mandatory	Incentive	Educational	New Construction	Existing Construction	Municipal	Residential	Commercial/ Industrial	Transportation
Option	Strategy									
Locate housing near employment and services	Zoning ordinance	X	X		X			X		X
	Real property tax abatements		X			X		X		
Increase use of mixed/multi use facilities	Zoning ordinance	X	X		X		X	X	X	
	Real property tax abatement for conversion		X				X	X	X	
Increase use of landscaping and shading	Zoning ordinance/subdivision regulations	X	X		X			X	X	
	Real property tax credit		X			X		X	X	
	Low interest loans		X		X			X	X	
	Grants to low-income household		X		X			X		
	Sales tax credit/exemption		X		X	X		X	X	
	Information service			X	X	X		X	X	
	Advertising campaign			X	X	X	X	X	X	
Increase use of multi-family housing	Zoning ordinance	X	X		X			X		
	Real property tax abatement		X		X	X		X	X	
	Major rehabilitation loans		X			X		X	X	

Source: Northern Energy Corporation, Planning the Energy Efficient Community, 1981.

Strategies for Energy Management in Building Envelope

		Character and Focus of Strategy					Strategy Energy Impact Area			
		Mandatory	Incentive	Educational	New Construction	Existing Construction	Municipal	Residential	Commercial/ Industrial	Transportation
Option	Strategy									
Increase weatherization and insulation in Richmond homes and businesses	Municipal ordinance	X			X	X		X	X	
	Building code amendment	X			X		X	X	X	
	Mandatory compliance at sale, resale, or lease through disclosure and inspection	X			X	X	X	X	X	
	Real property tax credits		X			X		X	X	
	Low interest loans		X			X		X	X	
	Sales tax credit/exemption		X		X	X		X	X	
	Individual plant consultation			X		X			X	
	Information services			X	X	X	X	X	X	
	Advertising campaigns			X	X	X	X	X	X	
	Civic awards for cooperating businesses			X					X	
Increase use of glazing and storm windows	Municipal ordinances for own operations	X				X	X			
	Municipal ordinances	X				X		X	X	
	Mandatory compliance at sale, resale, or lease through disclosure and inspection	X			X	X	X	X	X	
	Real property tax credits		X			X		X	X	
	Low interest loans		X		X	X	X	X	X	
	Grants to low-income households		X			X		X		
	Sales tax credit/exemption		X		X	X		X	X	
	Information services			X	X	X	X	X	X	
	Advertising campaigns			X	X	X	X	X	X	
Reduce glass area in buildings	Building code amendment	X			X		X	X	X	
	Rehabilitation loans		X			X		X	X	
	Real property tax credits		X			X		X	X	
	Advertising campaigns			X	X	X	X	X	X	
	Information services			X	X	X	X	X	X	

Source: Northern Energy Corporation, Planning the Energy Efficient Community, 1981.

Strategies for Energy Management in Appliances and Equipment

		Character and Focus of Strategy					Strategy Energy Impact Area			
Option	Strategy	Mandatory	Incentive	Educational	New Construction	Existing Construction	Municipal	Residential	Commercial/ Industrial	Transportation
Reduce energy consumption by reduced use or increased awareness of appliances consumption	Municipal ordinance	X			X	X		X	X	
	Zoning ordinance	X	X		X	X		X	X	
	Advertising campaign			X	X	X	X	X	X	
	Individual building consultations		X	X		X	X	X	X	
	Information service			X	X	X	X	X	X	
Reduction of energy consumption in the transportation sector	Driver education	X						X		X
	Excise tax	X								X
	Registration tax	X								X
	Personal property tax	X								X
	Gas tax	X								X
	City fleet size	X								X
	Parking rates	X								X
	Increase use of public transit		X							X
	Encourage biking and walking		X							

Source: Northern Energy Corporation, Planning the Energy Efficient Community, 1981.

Strategies for Energy Management in Operations

		Character and Focus of Strategy					Strategy Energy Impact Area			
Option	Strategy	Mandatory	Incentive	Educational	New Construction	Existing Construction	Municipal	Residential	Commercial/ Industrial	Transportation
Increase use of staggered work hours	Mandatory - municipal employees	X					X			
	Advertising campaign			X			X		X	
Four-day work week	Mandatory - municipal employees	X					X			
	Advertising campaign for businesses			X					X	
Increase vehicle maintenance	Education/information service			X			X	X	X	X
Increase carpooling and van pooling	Preferential traffic control		X							X
	Preferential parking		X							X
	Carpool matching service		X							X
	Lease vans to businesses		X						X	X
	Advertising campaign			X			X	X	X	X

Source: Northern Energy Corporation, Planning the Energy Efficient Community, 1981.

Appendix F

SELECTED NEWSPAPER ARTICLES CONCERNING KANSAS ENERGY ISSUES

Wolf Creek plant: Necessity or an economic disaster?

KCP&L chairman says need is clear

By Jim Sullinger
staff writer

Sitting in his 11th-floor office in the Kansas City Power & Light Building, Arthur J. Doyle ponders the impact of higher electric rates on the area.

KCP&L's board chairman is aware of the political storm swirling around the Wolf Creek nuclear power plant under construction near Burlington, Kan. The company's projection is for about a 50 percent increase in rates.

Despite mounting pressure his goal is clear: to begin the plant's commercial operation by next February.

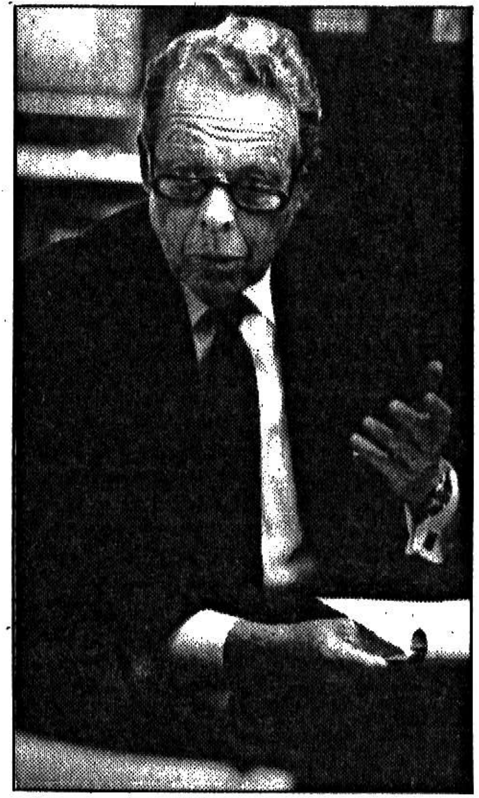
"There is no question that a 50 percent (rate) increase will have an impact on every customer, every customer's pocketbook and his disposable discretionary income," said Mr. Doyle, a 1949 Boston College law school graduate.

"Nobody's going to like it. I don't like it. But the problem is . . . just like we have in natural gas, which has gone up 500 and 600 percent."

When car prices rose, "sticker shock" became the phrase to describe the impact. Now the new phrase is electric rate shock.

"There will be hardships, just like there are when other items go up that are essentials, like natural gas," he said. "But people get acclimated to it. Wage increases accommodate to it. Social Security already has a built-in escalator."

In the company's phase-in plan, rates would be increased about 25 percent the first year and the rest in increments the following three years. Mr. Doyle estimated that the additional interest necessitated in phasing in the increase over four years would add 4 to 6 percent to the 50 percent boost.



Arthur J. Doyle
. . . predicts eventual savings

However, a Kansas Corporation Commission official said Monday that according to a KCC projection, a phase-in plan similar to KCP&L's proposal would increase the current average bill 104 percent over the four years.

Despite the present $2.67 billion cost of the plant—he expects that to be the final cost—and increasing rates to pay for it, Mr. Doyle staunchly defends nu-

See Chairman, pg. 6A, col. 1

Foe says facility is a bad investment

By Jim Sullinger
staff writer

Topeka—Mari Peterson is warning Kansans that the cost of the $2.67 billion Wolf Creek nuclear power plant threatens their economic lives.

Quiet and soft-spoken, the 27-year-old director of the Kansas Natural Resource Council is no anti-nuclear firebrand. While some groups play on radiation fears, Ms. Peterson uses the logic of economics as her persuasive tool.

This daughter of a Lutheran minister is in the vanguard of a growing consumer movement worried about Wolf Creek's impact on electric bills.

She preaches the gospel of energy conservation while asking for a halt to construction of the plant near Burlington in east-central Kansas, scheduled to begin operation in the spring of 1985.

She believes public awareness of the issue is growing, especially in Wichita where many consumers are organizing.

"Wolf Creek is a bad investment and our best course would be to abandon the project now," she has told groups at nine recent forums in Kansas, including one in Prairie Village.

As support she uses some dramatic figures:

- The increase in electric rates, she says, probably will be greater than either the 50 percent estimated by the Kansas City Power & Light Co. or the 95 percent estimated by the Wichita-based Kansas Gas & Electric Co. Each utility owns 47 percent of the plant.

The Kansas Electric Power Co-operative Inc., which serves 85,000 rural customers, has purchased the other 6 percent of the plant.

Mari Peterson
. . . urges shift to conservation

The KCP&L estimate does not include interest charges needed to finance its proposed four-year rate phase-in plan, which Ms. Peterson said could boost rates another 20 percent. Probably not counted, she added, is the average 8 percent annual increase for inflation.

And in a report that caught utilities and lawmakers by surprise, the Kansas Corporation Commission estimated Monday that a phase-in plan similar

See Foe, pg. 6A

Chairman

continued from pg. 1A

clear power and the decision to build Wolf Creek, of which KCP&L owns 47 percent.

Using a survey of 51 major U.S. cities, he said, the average cost of 750 kilowatt hours is $62.50. KCP&L, at $54.27, is 13 percent below the present average.

That average will be larger, he said, just prior to new KCP&L rates going into effect in 12 to 14 months.

At that time, Mr. Doyle said, he expects rates to be 20 to 25 percent below the 51-city average.

During the phase-in years, he said, the rates should be slightly higher than the average. Afterward he expects rates to drop below the average.

"Anytime a family is working on a budget or any business for that matter has an electric utility bill that goes up 50 percent, it's traumatic and it's not much consolation to say, 'but don't worry about it because the people on the East Coast or New York are paying more.' "

He said the utility has an obligation to be fair to ratepayers, stockholders and investors.

Mr. Doyle also defended the utility against charges that Wolf Creek gives KCP&L too much excess generating capacity.

"We have no excess capacity except that which is a prudent amount," he said, adding that utilities build in excess capacity to meet future electric demands.

Without Wolf Creek, Mr. Doyle said, reserve capacity in 1985 will drop to 12.9 percent. He said the minimum reserve needed to meet peak demands is 22 percent.

With Wolf Creek's 1150 megawatts, Mr. Doyle said, KCP&L will have a 37.2 percent reserve next year and a 24 percent reserve in 1990.

He said that when Wolf Creek critics use reserve capacity figures approaching 50 percent, they are including the four Hawthorn power plant units in Kansas City.

Although still operable, these units are not included in KCP&L's figures because they are old and are not reliable enough to be included in the company's reserve capacity, Mr. Doyle said.

He praised the Wolf Creek project for costing 9 to 10 percent less than other nuclear plants. He said Wolf Creek is costing about $2,300 a kilowatt. KCP&L estimates that coal-fired plants in 1985 will cost $1,120 per kilowatt to build.

Although coal plants are cheaper to construct, their fuel costs are much higher. The reverse is true for nuclear plants.

For the first 10 years of Wolf Creek's operation, Mr. Doyle said, customers would pay "a little more" for nuclear power.

"Then the lines cross, as compared to coal, and for the next 20 years they (ratepayers) have savings," he said.

Mr. Doyle said the company already had calculated the effect of increased consumer conservation because of the higher Wolf Creek rates.

The growth rate between 1981 and 2000 had been projected at 2.8 percent a year. Wolf Creek, however, has reduced that estimate to 2.1 percent.

Mr. Doyle denied that additional interest charges to finance the phase-in plan would add 20 percentage points to the rate increase, characterizing such fears as "bad math."

That might be about right, he said, if a proposed measure requiring a 10- to 15-year phase-in is passed by the Kansas Legislature.

Under KCP&L's phase-in plan, he said, additional interest charges would boost the total rate increase from about 50 percent to approximately 56 percent.

He scoffed at charges of project mismanagement and blamed rampant inflation and escalating red tape for the plant's price tag.

He also blamed anti-nuclear activists for delaying tactics, which he said have contributed to higher plant costs. He said their strategy now is to proclaim that the higher cost makes the project prohibitive.

"It's not a prohibitive cost," he said. "It's the cheapest piece of capacity I believe Kansas City Power & Light Co. will ever put into our system again because coal-fired plants are going to cost more."

Mr. Doyle said the U.S. increasingly had been turning to electricity as the price of oil and gas has increased. He said meeting electricity demands would be vital to the nation's growth.

"How do you sustain growth in the GNP (gross national product)," he asked, "without the energy to support it?"

Foe

continued from pg. 1A

to KCP&L's proposal would boost the current average bill 104 percent during the four-year period.

The 95 percent estimate by Kansas Gas & Electric includes interest on a five-year phase-in plan.

Ms. Peterson said she doesn't think either company is being honest about the rate increase.

- The plant is now costing $1.75 million a day or $2.64 a day for each of the more than 660,000 utility customers affected in Kansas and Missouri, she said.
- The plant's cost to each Kansas Gas & Electric customer is $5,219, and $3,621 to each KCP&L customer, she said.
- Her final prediction is the ultimate collapse of both utilities. As consumers reduce their use of electricity or convert to other sources of energy, the utilities will be forced to raise rates even more. She said this would force further conservation measures by ratepayers. Ms. Peterson said that economic spiral will ultimately bankrupt both utilities.

"They are on a razor's edge. The utilities have got to stop thinking growth and start thinking conservation," she said.

If the plant begins commercial operation her forecast for the economic future of residents is a bleak one: lights going out in the homes of the poor because electric bills cannot be paid; many persons, including the elderly, choosing not to run their air conditioners during the summer; businesses bypassing Kansas City for locations where electricity is cheaper; escalating taxes as government passes on its higher electric bills, and higher prices for goods and services as businesses pass on their higher energy costs to consumers.

The irony, she said, is that electricity from Wolf Creek is not needed.

When Wolf Creek goes on line, she said, KCP&L will have a reserve capacity of 46.6 percent. If an acceptable reserve for meeting peak demand is 18 percent, she said, that would leave the utility with an excess capacity of 28.6 percent.

KCP&L has estimated that Wolf Creek will push the reserve margin to 37.2 percent, contingent on deactivating four coal-fired units at its Hawthorn plant.

Figures provided last year by the Kansas Corporation Commission estimate the utility's reserve margin at 36.8 percent to 51.3 percent when Wolf Creek begins generating.

Ms. Peterson said that with a growth rate of 2 percent a year in the demand for electricity, extra electricity won't be needed for many years.

If construction was stopped now, she said, ratepayers would save 5.6 cents per kilowatt hour. She said that only 67 percent of the plant has been paid for and that utility customers could save the additional 33 percent, plus operating expenses and the subsequent cost of decommissioning the plant.

Ms. Peterson was graduated in 1974 from Augustana College in Sioux Falls, S.D., with a degree in economics and an obsession with the impact of escalating energy costs on the fabric of American life.

She co-founded an energy consulting firm in 1980 but left it a year and a half ago to direct the Kansas Natural Resource Council.

Neither she nor her small research staff have advanced academic degrees. She said, however, that research in energy economics has been her life for the last 10 years.

Ms. Peterson said the purpose of the council is to promote energy conservation and less costly forms of energy. Its budget this year is $65,000.

Funds come mainly from labor unions, conservation groups, law firms, the Kansas Farmers Union, the Kansas Wildlife Federation, solar energy companies and architectural firms.

She said many members belong to other anti-nuclear power groups. The group's attorney, John Simpson of Fairway, is a major figure among activists working against nuclear power in Kansas.

The council's president is Bill Ward, an attorney for the Environmental Protection Agency in Kansas City. Among the lawyers and university professors that make up the council's board is Ivan Wyatt, president of the Kansas Farmers Union.

The Kansas City Star, Sunday, February 26, 1984

Wolf Creek rate proposal spawns anger in Wichita

By *Ian S. Simpson*

taff writer

Wichita—Bury the Wolf Creek nuclear power plant and take the Kansas Gas and Electric Co. with it, hundreds of Wichita residents said Saturday.

Angered and frightened by a proposed electric rate increase of 95 percent, Wichita area residents gathered to tell Kansas legislators what they thought of Wichita-based Kansas Gas and Electric and its management of the Wolf Creek plant being built near Burlington in east central Kansas.

Scores of businessmen and other citizens said that the proposed 95 percent rate increase sought by the KG&E from 1985 to 1989 would have a devastating effect on the Kansas economy.

The utility and its stockholders should bear the burden of paying for the $2.67 billion plant, they said. KG&E, the managing partner of the plant, and the Kansas City Power & Light Co. each have 47 percent ownership of the facility. The remainder is owned by the Kansas Electric Power Cooperative Inc., a group of rural Kansas utilities.

According to recent published reports, the per-customer cost of the Wolf Creek plant to KG&E ratepayers will be the third highest in the nation. The part of the construction costs owed by Wichita-based utility will amount to $5,219 per customer, the *Wichita Eagle-Beacon* has reported.

"We ask KG&E to act not as a protected giant, but as a responsible member of the Wichita business community," said Richard Caliendo, a member of a Wichita business group seeking to mitigate the effect of the proposed rate increase.

Businessmen fear that businesses will leave the area because of high power costs.

"The entire cost of Wolf Creek should be borne by KG&E and its stockholders," Mr. Caliendo said.

Terry Garrison of the Electric Shock Coalition, a group opposed to the rate increase plan, said, "A Wolf Creek crisis is undoubtedly the most critical issue that has faced the Kansas Legislature in many years."

The coalition sponsored six meetings in Wichita churches Saturday morning to permit consumers to let their feelings be known to legislators.

About 200 Wichita businessmen affiliated with the Alliance for Liveable Electric Rates attended a meeting with a panel of legislators at the Broadview

See Protest, pg. 32A, col. 1

Hotel in downtown Wichita.

Those attending were not conciliatory toward Wolf Creek.

Nearly all of the 200 persons at Olivet Southern Baptist Church in northwest Wichita leaped to their feet when asked how many would be in favor of abandoning the nuclear power plant.

A woman who spoke on behalf of nuclear power was hooted by some of the 100 persons at the Pine Valley Christian Church.

No Kansas Gas and Electric representatives attended the meetings.

Howard Hanson, KG&E group vice president for finance, attended the businessman's meeting, but he declined to comment on complaints about management of the utility.

Wolf Creek, which is about 100 miles southwest of Kansas City, originally was estimated to cost $783 million. Now it is estimated to cost $2.67 billion before its scheduled operations begin in the spring of 1985.

KG&E's 230,000 customers would have to pay almost $250 million a year in additional payments if the cost of building Wolf Creek were imposed at one time. That cost could mean an average annual increase of $400 per household. And some major Wichita industrial customers, such as Vulcan Chemicals, would be paying several million more dollars annually, estimates have shown.

Once completed, Wolf Creek is estimated to have almost 58 percent more generating capacity than necessary for present KG&E customers, according to some published reports.

KCP&L has estimated that Wolf Creek will give it a surplus of 34.5 percent over peak demand. Critics of the utility say Wolf Creek will give KCP&L a capacity reserve much higher than that.

A capacity surplus of 15 to 20 percent is a rough industry standard, although KCP&L says it needs a 22 percent reserve.

Several bills pending in the Kansas Legislature deal with the proposed rate increase. The bills generally call for a lengthy phase-in of costs and exclusion of excess capacity and poor management decisions from the rate structure.

However, officials warned that there may be little that can be done to alleviate the problem.

State Sen. Paul Hess, chairman of the Senate Ways and Means Committee, said stockholders in KG&E and KCP&L probably would bear some of the burden of paying for the plant. But he added, "When it's all said and done the ratepayer will be the one to foot the bill."

The Kansas City Star, Monday, February 20, 1984

Cities, firms seek to trim power bills

By Jim Sullinger

The Star's Topeka correspondent

Faced with the hardships that a proposed 50 percent hike in electric rates could create, some Kansas businesses and local governments are looking into an alternative—generating their own power.

"A 50 percent increase would come right out of my hide," said Mickey Griffith, president of Sunset Plastic Products in Lenexa, which turns out more than a million plastic food containers a day. The company's electric bill already runs $20,000 to $50,000 a month.

"The only thing we can do is look at the possibility of generating our own electricity," Mr. Griffith said.

Mr. Griffith's reaction was spurred by a Kansas City Power & Light Co. proposal to raise rates about 50 percent over the next four years. The utility says it needs the higher rates to pay for its 47 percent share of the Wolf Creek nuclear plant near Burlington, Kan. The plant is expected to open in the spring of 1985.

Mari Peterson, director of the Kansas Natural Resources Council, said many businessmen are looking nervously at their bottom lines in anticipation of the rate increase. Her group opposes construction of the nuclear power plant.

Some companies and city governments are turning to energy alternatives such as producing their own electricity, which will take business away from KCP&L and its partners in the Wolf Creek plant, Ms. Peterson said.

"When that happens, it's going to be more expensive for the rest of us," the activist said.

But Joe Kramer, KCP&L's spokesman for nuclear power, said he did not believe businesses were preparing to flee the utility.

Mr. Kramer said companies may take steps to conserve more electricity because of the rate increase, but said that has been going on since the Arab oil embargo in 1973.

Mari Peterson

"The era of cheap utilities is behind us, and most people have adjusted successfully to this," Mr. Kramer said.

KCP&L has proposed a four-year phase-in of its rate increase: a 25 percent increase the first year and 8 percent each of the following three years.

To support her view that rates are driving businesses away from the utilities, Ms. Peterson cited the chemical division of Vulcan Materials Co. in Wichita. The firm is producing electricity from steam used in chemical production—a process called co-generation.

She said the loss of that business has cost Kansas Gas & Electric Co.

See Electricity, pg. 5A, col. 4

continued

$1.1 million.

KG&E, the major partner of KCP&L in Wolf Creek, also owns 47 percent of the nuclear facility and also is seeking rate boosts to pay for its share.

Some cities say the plant is causing them to look for alternatives.

The southeast Kansas town of Girard, for instance, is trying to dump KG&E service because of Wolf Creek, according to Richard Loffswold Jr., city attorney. He said many older persons living on fixed incomes in Girard cannot afford KG&E's proposed rate increase.

Girard wants to buy power instead from the Empire District Gas & Electric Co. in Missouri, the attorney said. He added, however, that KG&E officials are resisting that, and the dispute may end up in court.

At a meeting Thursday in Prairie Village, Ms. Peterson said the Boeing Military Aircraft Co. in Wichita also may leave the KG&E system.

James Foster, a Boeing spokesman, denied that but said the company always was looking at the feasibility of energy alternatives. He said the firm's electric bill last year was $10.6 million.

Jerry Mallot, president of the Wichita Chamber of Commerce, agreed with Mr. Kramer that not many businesses are going to flee the major utilities.

Mr. Mallot said electricity-intensive companies like Sunset Plastics and Vulcan Materials are in the minority. For most firms, he said, electricity amounts to less than 1 percent of operating costs.

Alternative fuels or co-generation would be more expensive for them than a phase-in of higher electric bills, Mr. Mallot said.

Wolf Creek costs prime issue

By LEW FERGUSON
Associated Press writer

How to cushion the impact of Wolf Creek nuclear power plant costs on consumers, which has become a prime issue of the 1984 legislative session, turns on the key consideration of whether to make utilities or customers pay for extra interest costs in a delayed phase-in plan.

A group of 46 House Republicans and Democrats is forcing the issue, without Speaker Mike Hayden's support, somewhat in conflict with what Gov. John Carlin, the Corporation Commission, and legislative leaders want to do, and definitely in conflict with what the utilities want done.

The dissidents may throw the issue into the sharpest battle of the session by the time of April adjournment — if efforts at a compromise collapse before the House Energy and Natural Resources Committee considers the issue again Monday afternoon.

There is considerable political posturing involved in the battle. The 46 House members are up for re-election this year, and want to be able to tell their constituents they were out front in trying to blunt the shock of rate increases when Wolf Creek starts operation next year.

The committee held hearings Tuesday, Wednesday and Thursday on three bills it has before it.

The measure introduced by the 46 House members would prohibit the Corporation Commission from ever allowing the three utilities building Wolf Creek to pass on to their customers the added cost of carrying the debt on that portion of the costs deemed to represent excess generating capacity over several years in a phase-in plan.

Another bill, offered by Rep. Ken Grotewiel, D-Wichita, would prohibit the KCC from allowing the utilities to put into their rate bases any of the costs of the plant which were attributed to bad management or which contributed to excess capacity.

The third measure, introduced by the House committee at the request of the KCC and supported by most of the legislative leadership, would allow the commission to determine which of the plant's generating capacity was not needed and establish a phase-in plan of its choosing.

Implied in that measure is that the KCC could allow — or disallow — the utilities the right to recover all their costs, including interest payments, over the course of the phase-in.

The utilities themselves have outlined a plan under which the entire $2.67 million cost of Wolf Creek would be phased in over a *five-year period — amounting* to a $63.3 million increase in interest charges.

Senate Majority Leader Robert Talkington told a news conference Friday the leadership is behind the KCC proposal.

"I think the general feeling is we should give the commission the power to do what it believes is in the best interest of both the ratepayers and the utilities. Hopefully, we'll give them the tools they need to work with," he said.

> "We made some effort at coming to some common ground; we're just not there yet. It's pretty ticklish."
>
> Rep. Robert Vancrum, R-Overland Park

That is Carlin's position as well, although he has not *specifically endorsed any of the bills.*

It is the lack of a prohibition against letting Kansas Gas and Electric Co. of Wichita, Kansas City Power and Light Co. and Kansas Electric Power Cooperatives Inc. (the three owners of Wolf Creek) pass the interest charges on money they borrowed to build the excess capacity portion of the plant on to the consumers that has the House members upset.

Both sides went into the weekend optimistic a compromise can be struck, but cautioning that the talks *are so delicate they could break down* before the committee meets at 3:30 p.m. Monday.

"We made some effort at coming to some common ground; we're just not there yet," said Rep. Robert Vancrum, R-Overland Park, one of the 46 sponsors of the bipartisan House bill. "It's pretty ticklish."

"I think there will be a good bill come out of the House committee," said Budget Director Lynn Muchmore, who has been involved in the negotiations on behalf of Carlin.

"*I think they're pretty close,*" said Brian Moline, chief attorney for the Corporation Commission.

Vancrum said the large group of representatives sponsoring House Bill 2927 are committed to "making certain actions mandatory."

"In the event the commission finds there is imprudently-built excess capacity, at the very least they ought to deny the interest costs," he added. "Yet they *don't want their hands tied at all.*"

"Any phase-in of costs which were imprudently incurred, which does not relieve reatepayers of paying finance charges incurred because of the phase-in is a hoax, a sham, that actually increases the burden they will have to bear," Vancrum told the committee Thursday.

While the added finance cost of a phase-in of the excess capacity is the big stumbling block to a compromise on the Wolf Creek bill, another issue is *whether the authority to allow the phasing in of plant* costs should apply only to electricial utilities or all utilities.

Moline said the Corporation Colmmission "submitted some changes for 2927 that would make it more workable from our standpoint — not make it restricted only to Wolf Creek."

"It would make all of those mandatory provisions (in the bipartisan House bill) discretionary," Moline added.

"*They want some mandatory language to deny carrying charges.* The compromise seems to be in the event the commission finds both excess capacity and management imprudence, then the mandatory provisions would take over. Otherwise, it would be discretionary."

Muchmore speculated the bill which comes out of committee would allow the utilities to recover all the costs — including financing costs — of that portion of Wolf Creek deemed to be required at the present time, and also would allow the KCC to phase in those costs.

However, he also speculated the bill would prohibit the utilities from passing on carrying costs on that portion of the plant's costs which are declared excess capacity and which are phased in at some time in the future.

"Look at the argument on its merits," the budget director said, "it's pretty hard to argue that if the company acted imprudently to create the excess capacity, that the consumer should have to bear the carrying costs."

Energy ‘wisdom‘ pushed

By Myron Levin

The Star's energy/environment writer

Local government should be helping citizens conserve energy instead of leaving the job to the marketplace or to dwindling federal programs, says a leading advocate of alternative energy use.

"The reason is that a dollar spent on energy has the worst impact on the local economy of any dollar spent," said David Morris, director of the Washington-based Institute for Local Self-Reliance, a non-profit energy consulting group.

"There are about a half-dozen studies that indicate that for every dollar that you spend on natural gas or electricity or coal or gasoline, about 85 cents leaves the community immediately," he said in an interview.

Mr. Morris, who was in Kansas City last week for community energy workshops, said Baltimore, Minneapolis and St. Paul are trying to prevent energy dollars from leaving their communities by using their bonding authority to raise money to make conservation loans.

This isn't a subsidy program, he said, since borrowers must pay market interest rates. But with repayment spread out longer than with the typical home improvement loan, the payments are low enough to be met with monthly energy savings, Mr. Morris said.

The community benefits because residents and businesses have more to spend for other purposes, he said. For the citizen "the bottom line is a very individualistic line. Individuals want to pay as little as possible for their basic necessities, of which energy is one."

Mr. Morris attacked the Reagan administration for maintaining federal subsidies for energy production while insisting that the market set the role of conservation and renewable energy sources.

He said that since the Arab oil embargo of 1973, it's been obvious "that the pricing structure of energy had changed in a way that made it competitive to save energy rather than produce energy."

During a decade in which the world price of crude oil rose 2,000 percent, energy conservation grew from a $100-million-a-year enterprise in 1973 to a $4 billion industry by 1979. This "put it on a par with national sales of pornographic material," he joked. Last year, energy conservation was a $10 billion business, which made it one of the biggest industries in the country, he said.

While these robust figures suggest no government help is needed, Mr. Morris said "the marketplace actually does not work well" in helping most people save energy.

For example, poor people have the most to gain from conservation because they live in the leakiest homes and have the least money to spend on utility bills, Mr. Morris said. But since they don't have savings, and banks won't lend them money, high-price energy "has reduced their standard of living but cannot prompt them to invest."

Then there are the millions of tenants who would like to protect their dwellings against the weather but won't because their investment would "benefit the landlord, not the renter, who will move in a short period of time," he said. And "the landlord will tend not to invest because it's often the renter who'll pay the energy cost."

The homeowner who applies for a small loan to weatherize his home often can only get a standard home improvement loan that must be repaid in a couple of years, Mr. Morris said. If the borrower could stretch his debt over several years, the monthly payments would approximate the monthly energy savings. As it is, the steep monthly payments can "deter even the middle class from taking out a loan."

So while rising energy costs make conservation a good buy for everyone, "the marketplace does not translate that into the types of investments that would be economical (for the) rational consumer," Mr. Morris said.

But with its greater financial resources and ability to act for the long-term, a city or county can help residents overcome such barriers, he said.

In this area, the Gas Service Co. has proposed that up to $4 million a year from a surcharge on industrial customers be used to make conservation improvements in low-income households. Federal funds to insulate low-income homes are being sharply cut by the Reagan administration, so the Gas Service plan would help take up the slack.

While praising the idea, Mr. Morris said $4 million would benefit just a fraction of those needing help in any given year, but a loan program would stretch the money so it doesn't disappear in 100 percent grants.

COMMUNITY ENERGY PLANNING IN MARYSVILLE, KANSAS

by

STEVEN SCOTT ERNST

B. S., Kansas State University, 1977

AN ABSTRACT OF A MASTER'S REPORT

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'ABSTRACT'

Community energy planning is one response to the increasing problems associated with increased energy costs. A basic premise of local energy planning is that the community is the most logical, appropriate and effective level to address the problems and opportunities of the transition from an energy base dominated by non-renewable sources to one dominated by renewable energy sources.

In Kansas nearly 50 percent of the population lives in cities under 20,000 population. Small cities are experiencing a renewal of population growth, a reversal of a more that 200 year trend of migration to larger urban areas. Marysville, a small city of approximatly 3,670 population in northeast Kansas, was selected for a case study in community energy planning. The parts of the community energy planning process adressed in in the study are: 1) the community energy audit, 2) the comparison of different future energy demand and supply scenerios, 3) identification of alternative strategies.

The physical components and energy profile for Marysville are based on actual energy demand data collected both in surveys and directly from the utilities. The 1982 energy demand assessment found that the estimated total end use energy of 371,363 Mbtu was consumed in the sectors as follows: residential 58.5 percent, transportation 20.0 percent, commercial 15.7 percent, schools 3.6 percent, and municipal 2.0 percent. In terms of energy type, natural gas accounted for 61.4 percent, electricity 18.4 and petroleum 20.2 percent of total end use energy. The 1982 total end use energy cost is estimated to be $2,491,965. The average household share of the total community energy costs is $1,642 which is 10.3 percent of the median household income. Based on estimates of the amount of energy expenditures retained in the local economy, $2.2 million, or 87 percent of the total energy expenditure directly left the local economy.

Year 2002 projections are made based on the 1982 energy demand assessment for two future energy scenerios:

1. Business As Usual - assumes little change in the 1982 energy efficiency levels, per capita energy demand increases by 1 percent; average household share of total community energy costs are $5,494 or 27.6 percent of the projected median household income.

2. Soft Path - consists of two basic strategies that reduce nonrenewable energy demand by a total of 70 percent from the the Business as Usual level and reduce average household share of total community energy costs to $1,920 or 9.6 percent of projected median income.

   a) Strategy One - reduces energy demand through conservation, improving end use energy efficiency and solar ther-

mal measures which reduce per capita energy demand by 54 percent. It is estimated that one year jobs could be created implementing Strategy One. It is also estimated that implementing these measures would cost $2,829 per household and would save $40,349 in energy costs over 20 years.

b) Strategy Two - the utilization of renewable energy technologies supply a total of 16 percent of the post-Strategy One nonrenewable energy demand; electricity is generated from hydro-power, wind and photovoltics, natural gas is replaced in part by wood energy and sewage and solid wastes supply gasoline and diesel substitutes. It is estimated at currect costs that these measures could be implemented at a cost of $5,569 per household with a energy cost savings of $17,889.

The economic arguement for the Soft Path energy future scenerio is a strong one. An equally strong arguement for the Soft Path can be made from the wider perspective of energy insecurity. The present complex 'brittle' energy system is prone to sudden, massive failures with catastrophic consquences. The disruptions may be casued by natural events, accidents or human actions. The Soft Path energy future would give the energy system resiliency or the ability to withstand large disturbances from the outside.

The evidence is overwhelming that the energy transition can be an opportunity to create a more self-reliant, affordable and sustainable energy/economic future for Marysville and other small (and large) cities. Creating a desireable energy/economic future includes at least the following basic elements;

1. Vision -- of what is a desirable energy/economic future which becomesa flexible guide of individual and community action.

2. Leadership -- in knowing who is important in the process of local energy decision-making is as important as knowing the community's energy problems and potentials.

3. Tools and Techniques -- that can move individuals and the community