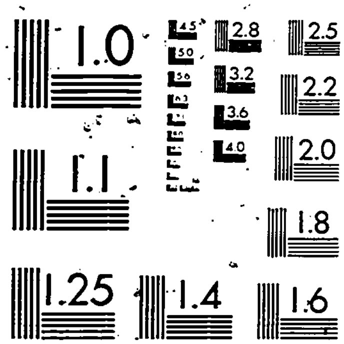

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ABSTRACT

This report examines the broad topic of energy use and its relationship to lifestyles. The emphasis is on three energy conserving lifestyle models: (1) the rural alternative lifestyle; (2) new towns; and (3) energy conserving subdivisions in existing cities. The first chapter presents an introduction. Chapter two examines the back-to-the-land movement, looking both at individual homesteads and communal living. Chapter three examines developer-designed new towns, such as Reston, Virginia and Irvine, California for energy conservation possibilities and lifestyles. Chapter four considers energy conservation in existing communities including: (1) voluntary conservation measures; (2) insulation of buildings; and (3) the microclimate within the subdivision. The final chapter identifies and evaluates obstacles to the wider adoption of energy conserving lifestyles. (Author/MR)

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ENERGY CONSERVING LIFESTYLES

Final Report to the California Energy Resources Conservation and Development Commission

Seymour I. Schwartz

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Davis, California 95616

April 1977

Preface

During the period of this study, changing conditions in California and the nation have made the topic of low energy lifestyles even more timely than when this study began (March 1976). In California, the Energy Resources Conservation and Development Commission has placed increasing emphasis on conservation as part of their program. At the national level, the frigid winter of 1976-1977 and the ensuing natural gas shortages made the nation and the State more aware of the limitations of energy supply and the need for conservation. This awareness has been reinforced by President Carter's energy policy, which stresses the desirability of life-style changes for conserving energy.

The present study examines energy conserving ways of living, with emphasis on three innovative modes--the rural alternative lifestyle, new towns, and energy conserving subdivisions in existing cities. While we look at ways in which the experimenters with these lifestyles are actually saving energy the view is toward possiblities for the adoption of energy conserving measures by the larger population.

The shape of the present report is the result of a variety of circumstances. Initially, my objective was simply to survey a variety of these experiments using the literature and limited interviews. However, fortuitous circumstances permitted the undertaking of detailed field studies in two of the areas of the project. The field studies were possible only because of the presence at the University of California, Davis, of several knowledgeable and enthusiastic persons who were willing to join me on research of mutual interest. It has been my pleasure and good fortune to have worked with Professors Bruce Hackett (Department of Sociology), Edward J.

Blakely (Applied Behavioral Sciences), and Glenn R. Hawkes (Applied Behavioral Sciences) and Ms. Janice Hamrin. The task was aided further by small amounts of financial support from the University of California.

Professor Hackett played a major role in developing and carrying out the survey of alternative lifestyle persons reported in Chapter 2. His previous research in communal living and knowledge of alternative lifestyles was vital to the effort. He conducted several of the interviews and supervised those conducted by Edward Vine, our research assistant for this part of the project. We are indebted to Mr. Vine for the excellent work he did, which sometimes required many hours of tramping through the hills of Mendocino County in temperatures above 105°. His rapport with the respondents was crucial to obtaining the detailed and personal information.

The study of an energy conserving subdivision in Davis, California reported in Chapter 4 has been a joint effort among Ms. Hamrin, and Professors Blakely, Hawkes and myself. Ms. Hamrin played a major role in developing the survey questionnaire and interviewing the residents of the subdivision. I am also indebted to her for reading various drafts of this report and contributing valuable comments and suggestions for its improvement. We expect to continue monitoring the progress of this subdivision for several years and to report results periodically.

My collaborators and I are indebted to a large number of individuals for their exceptional cooperation. Anon Forrest and Saul Krimsly, United Stand leaders (Ms. Forrest is also a Commissioner on the State Housing and Community Development Commission), contributed greatly to the success of the survey. They helped design our questionnaire and enthusiastically shared their extraordinary knowledge of who's who in Mendocino County as

well as opening doors which would otherwise have been closed. Our task in gathering information about the energy conserving subdivision in Davis (Village Homes) was aided greatly by the exceptional cooperation of Michael and Judith Corbett, designers and developers of the subdivision, and John Hofacre, designer. Don Cameron, Gordon Jones, and Dayne Stiles of the Irvine Company's planning staff generously shared their extensive knowledge of the gargantuan task of building a new city and gave me an information filled guided tour of Irvine.

Dr. William Ahern, Project Manager for the California Energy Resources Conservation and Development Commission, contributed significantly to the substance and shape of this project and to my enjoyment in carrying it out. I wish to thank him for many stimulating discussions and for his attention to administrative matters, which made my task far easier.

Finally, the outstanding secretarial support given me by Linda Thomas is gratefully acknowledged. Inquiries about forthcoming reports on work still in progress should be made to me at the Division of Environmental Studies, University of California, Davis, California 95616.

S. I. Schwartz

Davis, California

April, 1977

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Chapter 1. Scope of the Study

Introduction

Since President Carter's energy policy message to Congress, the subject of lifestyle change to conserve energy has been widely discussed. A dominant reaction is that making do with less is not part of the American dream. Yet, in recent years, many Americans have voluntarily chosen to reject that dream in favor of a simpler lifestyle with lower consumption of energy and other resources.*

The present study addresses the broad topic of energy use and its relationship to lifestyles. Of special interest is energy use among individuals who have chosen innovative or alternative lifestyles which are characterized by low energy use or have the potential for relatively low energy use. We examine in detail the rural alternative (back-to-the-land) lifestyle and two others, much closer to the mainstream--new towns, especially ones designed for energy and resource conservation, and energy conserving communities within existing cities.

Although much has been written about alternative lifestyles and their energy conservation possibilities, research on the subject is virtually nil. As an example, a recent major study by Dorothy Newman and Dawn Day (1975), sponsored by the Ford Foundation Energy Policy Project, obtained highly detailed information about personal energy use in the United States. While the aggregate information about nationwide energy use is valuable, by the authors' admission the study does not relate energy use to lifestyles or consider innovative lifestyles. A review of this work by Alfred Heller, President of California Tomorrow, is insightful: "What seems to me to be

* This movement has been referred to as "voluntary simplicity" (VS) by Elgin and Mitchell (1976) and other writers.

missing in this discussion of energy and the way people live is an account of the many serious experiments now under way to develop new lifestyles which conserve energy and other resources...Some of the people interviewed in the chapter on 'The Way Some People Live' seem to want to practice energy conservation, but don't know quite how to go about it" (Newman and Day, 1975; p. 305).

The present report represents an initial effort to identify and examine some of these serious experiments. It describes several energy conserving lifestyles, looks at energy use and the factors that explain lower than average use, identifies problems associated with the obstacles to the wider adoption of such lifestyles. By looking at the experimenters we hope to identify possibilities that are applicable to larger numbers of individuals in their present situations.

Energy conserving lifestyles. Lifestyle is a widely (and loosely) used term that probably brings different images to mind for each individual. Lifestyles are often characterized by occupational or social status, e.g., blue collar, executive, jet-set, by location of residence, e.g., urban, suburban, rural, or by dominant recreational activity. What identifies an individual as participating in a specific lifestyle category may often be unclear--i.e., lifestyle definitions are imprecise. However, we believe that different lifestyles are identifiable by some combination of attitudes, mannerisms, and more importantly, activity and consumption patterns.*

Our concern in this study is with energy conserving lifestyles or more specifically, with changes in activity patterns or consumption that

* Social scientists have made a start toward examining lifestyle differences by analyzing the use of time (activity analysis) of different social groups in various countries (see Ferge, 1972; Hammer and Chapin, 1972). Although activity analysis is potentially useful, we believe it is too limited a means for identifying and capturing the essence of different lifestyles.

result in less energy use than would otherwise be the case. This is a relative rather than an absolute standard--it is possible to practice an energy conserving lifestyle while, at the same time, participating in another (dominant) lifestyle.* However, of special interest to this study are low-energy or frugal lifestyles--those which are identifiable as consuming much less energy than the average for the society.

Scope of the Study

In Chapter 2 we examine the back-to-the-land movement (rural alternative lifestyle), looking at both individual homesteads and communal living. The nature of the movement and its lifestyle, the consumption of energy and other items, the economic effects, and some of the problems encountered by this lifestyle are described. Although the simple life is not so simple, it is frugal, especially with regard to the consumption of nonrenewable fuels.

In Chapter 3 the energy conservation possibilities and lifestyles of American new towns of the 1960's and 1970's are considered. Reston, Virginia and Irvine, California, both satellite new towns which are typical of the developer designed community (although unique in other respects) are described in detail. In contrast, we also look at a very different type of new community--Cerro Gordo, Oregon--which was designed by a group of its original members. This community emphasizes energy and resource conservation and close interpersonal relationships in a small rural setting.

In Chapter 4 we consider housing and subdivision design in existing communities capable of reducing energy use for heating, cooling, transportation and other purposes. Voluntary or governmentally imposed measures

* Elgin and Mitchell (1976) consider frugal living (voluntary simplicity) as a dominant lifestyle.

that affect the orientation and design of structures, the insulation of buildings, and the microclimate within the subdivision are included. Regulations in the City of Davis and an innovative subdivision in that city are described and evaluated.

In Chapter 5 we identify and evaluate the effects of a variety of obstacles to the wider adoption of lifestyle changes that are capable of reducing energy use. Both individual and societal factors are considered as well as some social implications of adopting various changes. A concluding comment in Chapter 6 completes the report.

Chapter 2. "Back-to-the-Land": Rural Communes and Homesteads

2.1 Introduction

In this chapter we focus on those persons who have chosen rural life as an alternative to the urban lifestyle. Both communal and individual forms of the back-to-the-land movement are considered as well as those living arrangements that fall somewhere in-between. We examine the background of the movement, its extent in Northern California, the characteristics and lifestyle of its participants, and their energy use.

2.2 Background

The appeal of the back-to-the-land movement can be traced, at least in part, to our history of anti-urban attitudes and the idyllic portrayal of rural life, with its virtues of simplicity, self-reliance, friendliness, and healthfulness. Theologian Harvey Cox attributes part of the reason for this anti-urbanism to long-standing religious beliefs:

> ...there has always been a streak of anti-urbanism in American culture. Not only have intellectuals often sided against the city in the course of American history, but our religious tradition also harbors a kind of anti-urban romanticism. As a theologian I am painfully aware of the extent to which American religious piety has fed a yearning for the idyllic and rustic and therefore contributed to the distrust and fear of cities which has so marred our national character. (Cox, Foreword to Campbell, 1976; p. xi.)

Nostalgia for an earlier and simpler age, devoid of many of the stresses of modern urban life, has been widespread, especially in recent years. However, it was not nostalgia alone that caused an increasing number of urban dwellers, especially young people, to move to rural areas in the late 1960's and 1970's. The disaffection of many young people with American society in the 1960's undoubtedly provided a major impetus to the rural migration. Many young people who felt that they were, in Paul Goodman's term, "growing up absurd" and were unable to influence their elders to solve the problems of militarism, racism, and environmental pollution became convinced that "the system" was unworkable and that change could not come from within. The alternative was to drop out. Most dropouts remained in urban areas in the mid and late 1960's. It was not until what Kern, et. al., (1976) call the demise of "flower power"--the deterioration of conditions and the increase in violence in hippie enclaves, which he dates as 1968--that large migrations to rural areas took place. Thousands left San Francisco's Haight-Ashbury district for rural parts of northern Califonia and elsewhere.

The literature on communes and alternative lifestyles (Kanter, 1972; Kanter, ed., 1973) as well as interviews, indicates that few individuals had the resources to buy land immediately but some eventually raised the money and are homesteading today. Many traveled from commune to commune, perhaps crashing at "open land" communes such as Morningstar or Wheeler's Ranch in Sonoma County (Wheeler, 1975), each of which housed several hundred persons at one time. However, many back-to-the-land migrants in recent years were not flower children of the 1960's. Some are older persons--artists, writers, craftsmen, and professionals who became disenchanted with the "rat race"--while others are young people who are often well educated and have chosen not to pursue a more conventional urban lifestyle. Reasons for the appeal of the rural lifestyle are varied, including the belief that there are no satisfying mainstream jobs, that regular jobs require undesirable sacrifices, and that the simple life, lived in touch with nature in an ecologically sound way, is better than one of high consumption.

The back-to-the-land movement has received considerable favorable publicity by the national media, which have stressed the virtues of the self-reliant, simple, rural life. Media treatment and surveys (Elgin and Mitchell, 1976) indicate that this lifestyle touches a responsive chord in many harried urbanites, who wish they were free to make such a change but feel they cannot. The movement has generated its own publications, which promote the back-to-the-land lifestyle and provide "how to do it" information for back-to-the-land people and sympathetic city people who may be contemplating such a move or could utilize the information in urban settings. The Mother Earth News, with its down-to-earth, nostalgic tone, offers information about farming, gardening, homebuilding, various crafts and home production activities, advertises products that can improve the homesteader's life, and carries many classified ads placed by individuals who are seeking others to join their back-to-the-land venture.

Another important alternative lifestyle publication, Stewart Brand's CoEvolution Quarterly, an outgrowth of the Whole Earth Catalog, provides similar information but is much more intellectual and eclectic than Mother Earth News. Popular topics include ecology and systems theory (with frequently esoteric contributions by well known academic theorists), space colonization, politics and society in theory and practice, as well as the more "traditional" appropriate technology and do-it-yourself ideas. There is an important difference in philosophy between Brand and the rural self-sufficiency promoted by the Mother Earth News which is best expressed by Brand's article on "Local Dependency" (CoEvolution Quarterly, No. 8, 1975, p. 5).

> Self-sufficiency is an idea which has done more harm than good. On close conceptual examination is is flawed at the root. More importantly, it works badly in practice.

> Anyone who has actually tried to live in total self-sufficiency--there must be now several thousands in the recent wave that we (culpa!) helped inspire--knows the mind-numbing labor and loneliness and frustration and real marginless hazard that goes with the attempt. It is a kind of hysteria. (Underline added)
>
> ...self-sufficiency is not to be had on any terms, ever. It is a charming, woodsy, extension of the fatal American mania for privacy.
>
> It would seem that the more fundamental statement is one of dependency. We can ask what kinds of dependency we prefer, but that's our only choice.
>
> ...I'm betting that abandonment of illusions of self-sufficiency will free us up to accept and enjoy local dependency, by preference.*

Many books useful to back-to-the-landers and city people are reviewed by CoEvolution Quarterly and, to a lesser extent, the Mother Earth News. It is evident from the book reviews and advertisements that there are thousands of titles that have been published in recent years, although some precede the movement of the mid-1960's. Presumably many of these titles have reached a suitable audience. Two of the most important back-to-the-land books came not from the 1960's or 1970's but from predecessors of the present movement who migrated to rural areas many years ago, Ralph Borsodi in 1920 and Helen and Scott Nearing in 1933.

Both Borsodi's Flight from the City (1933) and the Nearings' Living the Good Life (1954) are articulate, sensitive and informative works which make a powerful case for a relatively self-sufficient rural life. Borsodi and his family left New York City in 1920 to establish a homestead in rural upstate New York within 50 miles of the city. The Nearings, also New York

* We did not find anybody who espoused the total self-sufficiency that Brand is alluding to, although I do not doubt that such persons exist. Most alternative lifestyle people that we talked to were very much concerned about personal interactions and achieving a "sense of community." Probably, most persons who speak of self-sufficiency really mean greater self-reliance but within the context of local dependency.

residents, left to establish their homestead in Vermont in 1933. The circumstances of their respective flights from the city are somewhat different. Borsodi, a journalist, did not break his economic ties to the city immediately but continued to work on a part-time basis while commuting to his homestead. The Nearings did not have that choice, having been blacklisted from their teaching profession because of their political writings. Thus, their economic break with the city and the cash economy was much more complete than was Borsodi's. Borsodi was able to become less and less dependent upon a salaried job and eventually earned his money from writing books.

Both books describe in detail the day-to-day activities of each of the households, especially the production of food and construction of houses. The authors were greatly concerned with establishing independence from the cash economy by means of home production. This strong desire for independence from the cash economy is inspired by the practical belief that most people would be more secure, and happier in their work and lives if they could establish such independence. This belief is based on a thorough, aand at times profound, analysis by Borsodi of the economic system and its effect on people's lives, especially salaried workers in lower and middle level jobs. Borsodi's analysis could be read profitably today, especially by those seeking theoretical as well as practical support for their back-to-the-land venture or for the entire movement.

Both households successfully met their own food and housing needs, and the Borsodi's produced clothing as well. The Nearings were able to develop an export crop--maple syrup and maple sugar--which they sometimes sold but more often traded for food and non-food items which they were unable to produce, e.g., nuts and fruits which they obtained from California.

There were large differences between the two households in their view toward, and use of, technology. Borsodi believed that the use of appropriate technology was essential to efficient home production and the availability of adequate time for pursuing his writings, which were a major source of cash income. Thus, the Borsodi homestead had electricity and a wide variety of appliances. By contrast, the Nearing homestead was a model of low energy use. Its major source of energy for home heating and cooking was wood; for home building, farming (gardening) and woodcutting, it was hand labor. Concrete for their superb stone houses was mixed by hand mixer, and their large gardens were plowed by an animal-drawn plow. Their only concession to modern technology was a pickup truck, which they admitted was an invaluable piece of machinery. During the 10 year period during which they built their main house and several guest houses and sheds (all of stone) their trusty pickup truck made 5500 trips to haul gravel and sand. Although the Nearings' homestead required a large amount of hand labor, they worked no more than four hours per day, on average, to produce their food and shelter. The remainder of their time was spent in writing, other creative activities, visiting with friends, and some travel. Despite their modesty in claiming that anyone in reasonably good health and possessing a normal degree of intelligence could do the same, their account demonstrates that their success at living the good life--satisfying their material needs and maintaining leisure for artistic and cultural pursuits--is attributable to their extraordinary organizational abilities, discipline, industriousness and knowledge.

These authors deal not only with the economic well-being and personal satisfactions of their lifestyle but also with its health producing benefits. Both Borsodi and the Nearings commented on the excellent state of their health which they attribute to their lifestyle of hard but creative work and excellent nutrition. It would be difficult to argue with the record. Ralph Borsodi, now in his eighties, is still writing extensively and working on his farm in New Hampshire. Helen and Scott Nearing are actively homesteading today on their second homestead, this one in Maine. Scott Nearing is in his nineties and Helen Nearing is in her seventies (Wheeler, 1975; Mother Earth News, No. 44, 1977).

2.3 The Back-to-the-Land Movement in California

A. Extent of Participation

As already noted, major difficulties occur in precise definition of persons in this category, and even greater obstacles are encountered in gathering data about their activities. Recent population data and interviews with United Stand* leaders provided a basis for the following estimates.

United Stand leaders estimated that there are 3,000 to 4,000 non-code houses in Mendocino county owned by alternative lifestyle persons. This estimate is based on the membership of 1200 in the county and the leaders' personal knowledge of the number of non-member owners. Because of the wide variety of living arrangements it is difficult to estimate accurately the average number of persons per household with available data, but 3 per household seems reasonable. With this assumption the estimated

* United Stand is an organization of alternative lifestyle persons who organized in February 1974 to fight Mendocino County's attempt to force some homeowners to vacate and destroy their houses, which violated the uniform building code. (For details see Kern et al., 1976 or Mother Earth News, No. 39, 1976).

participation in the back-to-the-land movement is somewhere between 9,000 and 12,000 out of an official county population of 57,600 (1975 estimate by the State Department of Finance). The estimated alternative lifestyle participation seems high if one examines population changes in the county from 1970 to 1975, which show a total population gain of 6,300 during this period and a net migration of 4,700. However, there is cause to believe that official population estimates are subject to some error since an accurate census of people living in the hills is extremely difficult, and United Stand persons commented that many alternative lifestyle people have not been counted by census takers.

Population estimates made by the State Department of Finance each year are based on calculations of births and deaths from previously established population figures (the U.S. Bureau of the Census decennial census is assumed to be perfectly accurate) and from migration rates, which are estimated by several methods:

a. School enrollment changes, which are used to calculate population changes for all ages based on the past population structure of the county.

b. Drivers license address changes.

c. Federal income tax returns.

d. A regression model that uses births, deaths, school enrollment, vehicle registration and voter registration as independent variables.

The Department of Finance also carries out evaluation studies to check their estimates against a census of the county. They have completed censuses of 30 counties, including Nevada, but have not done Mendocino. A senior staff member said they check every piece of real estate in the county, using the services of four wheel drive clubs to cover the back country. He said their Nevada County evaluation study showed that their estimates exceeded their census count by 2% (Rasmussen). This is the expected direction of error if people are missed in the actual count but are picked up by the indirect estimate. Of the methods for estimating migration indirectly, it appears that only school enrollment changes are capable of being reasonable predictors of the change in population of alternative lifestyle persons, and this may also be highly inaccurate for two reasons--some households may not be sending their children to public schools, and the age structure and proportion of children to adults in the alternative lifestyle population may be much different than that of the general population. Both of these errors would underestimate the alternative lifestyle population. When asked about the difficulty of enumerating people in the backwoods, this official commented that it is difficult to count people who do not want to be counted.

In Nevada County, United Stand leader Mary Simms estimated that there are 900 to 1,000 known homes constructed without benefit of permits (<u>The Union</u>, Grass Valley-Nevada City, January 28, 1976). It is reasonable to assume that Ms. Simms is referring to non-code housing built by alternative lifestyle people rather than by old time residents, which is also a common phenomenon, and complicates the problem of estimating participation. Using the same ratio as for Mendocino County, we would estimate somewhere in the vicinity of 3,000 alternative lifestyle people in Nevada County.

<u>State Department of Finance Population Data</u>. The State Department of Finance population data provides another, although even less direct, source of information. These data show a reversal of migration trends in the rural

northern counties from those of the 1960-1970 decade. There are nine counties in this group whose population increased more than 10% from 1970 to 1975. Lake County, Nevada County and Trinity County all showed gains larger than 25% during this time period (Table 2-1). The Department of Finance figures for the ten counties with the largest population gains (Humboldt County in addition to the nine which had percentage gains greater than 10%) is 67,000. The net migration estimates for these ten counties for the 1970-75 time period is 56,600. Of the total population gain of 67,000, almost 80%, or 53,500 was in unincorporated rural areas. Certainly, while not all persons who migrated to rural areas are home-steading or living in communes, the likelihood exists that substantial numbers are doing so. If we subtract the growth in urban areas from the total net migration, we obtain 42,500 as the total number migrating to rural areas, which is an underestimate because the urban growth figure of 14,100 would include natural population growth as well as migration. Therefore, the net migration to rural areas is likely to be somewhat higher than 42,500 for the ten counties. If Sonoma County is included in this group the total net migration is 88,000. Since it contains the rapidly growing cities of Petaluma and Santa Rosa, much of the gain may be seen as a suburban migration from San Francisco. However, Sonoma County also has large numbers of back-to-the-land persons.

While it is hazardous to estimate the participation in this category it seems certain that the number is in the tens of thousands in the rural northern counties.

B. Who Are the Participants?

It is evident that diversity of backgrounds among participants in alternative lifestyle communities is considerable. Even in Mendocino

Table 2-1. Population Changes of Northern California Counties, 1970-1975[a]

County	Population Gain (1970-1975)	% Gain (1970-1975)	Net Migration
Butte	14,000	14.6	13,600
Placer	12,000	16.0	10,800
Shasta	9,700	13.0	7,200
Nevada	7,400	28.9	7,500
Mendocino	6,300	13.0	4,700
Lake	5,700	30.8	6,700
Humboldt	4,300	4.4	400
Sutter	3,900	10.4	1,900
Plumas	2,300	19.7	2,000
Trinity	2,000	26.3	1,800
Subtotal:	67,600		56,600
Sonoma	41,200	16.8	35,600
Total:	108,800		92,200

[a] State Department of Finance, preliminary estimates, July 1975. (Revised data forthcoming in U.S. Department of Commerce, Bureau of the Census.)

County it was pointed out to us by several people that backgrounds are quite different between coastal dwellers and inland dwellers. The inland people living near Ukiah tend to be in their 20's or early 30's, are largely from middle class origins in urban areas, and are well-educated--most have attended college and many have college degrees. A number of persons were early participants in the counterculture movement.

Most of the people interviewed, but especially the inland dwellers characterized themselves as simple people, striving for a frugal lifestyle that is rich in personal relationships and non-material rewards. They value self-reliance and individualism highly and see government as reducing their freedom. Some identify their political views as libertarian or "anarcho-decentralist," believing that the State should not interfere in people's lives, especially where property rights are concerned. Although they subscribe to the same environmental ethic held by environmentalist groups, they disagree sharply over means and oppose the regulation of land use and other regulatory actions to maintain environmental quality.

Alternative lifestyle people in coastal areas of Mendocino County are much more diverse than the inland people, ranging from U.C. professors who live there part time, to transient squatters who have few resources. In general, there seem to be more older and highly educated people in the coastal areas--artists, craftsmen, writers, and professionals. Coastal people were described as being more spiritual than the inland people, that is, as being more "into their own head,"--i.e., interested in mysticism, eastern religions and personal growth--and less committed to the self-sufficient sort of homestead production characteristic of inland dwellers. However, our survey did not show that coastal residents were less self-reliant with regard to the production of food and housing.

It is clear that alternative lifestyle persons are quite concerned about reducing their material consumption, and feel that their lifestyle is the result of a conscious choice over higher consumption alternatives. Their low cash income, which for most households is well below the official poverty line, is seen as the result of the choice of a simple, frugal lifestyle, i.e., their lifestyle does not require a large cash income. Consequently, people who make this choice are able to see themselves as free of the domination and demands of a steady wage-paying job. However, as we shall discuss later, this feeling of freedom does not mean independence from the cash economy; alternative lifestyle people cannot meet all of their material needs without relying on the cash economy--usually in the form of part-time employment.

Despite what is generally perceived as highly positive attitudes towards living the simple life, many participants in that lifestyle did not choose it initially because of its positive features. The return to the land was, for many, the result of dropping out from an urban society in which they were unable to function with dignity.* However, even though the flight from the city was the result of intolerable social and psychological conditions for many of those who migrated, it would be incorrect to assume that a positive commitment to the virtues of rural life does not exist. It was explained to me that it is extremely important for such a commitment to rural life to exist in order for people to be successful because conditions are sometimes difficult--people are isolated and work is hard. If one is not strongly committed, then the difficulties of making

* Paul Goodman (1970) commented that survival and maintenance of personal integrity is the life's work of today's hippie, which is in contrast to the more utopian goals of communes of an earlier period.

the rural life workable can be very great. Most of the people interviewed said they are strongly committed to their rural lifestyle and have no intention of returning to urban life.

Because of their urban backgrounds and sometimes negative reasons for migrating to rural areas, one would not expect to find adequate preparation for farming, homebuilding, and other activities necessary for a successful rural life. This expectation is confirmed by the survey. However, it is evident that by trial and error, which includes learning from various published sources, and from neighbors, many of the rural migrants have acquired considerable skills, as evidenced by the extent of home building and other home maintenance and production activities.

2.4 Energy Use Characteristics

A survey questionnaire was prepared in consultation with knowledgeable alternative lifestyle persons (United Stand leaders). (The questionnaire is reproduced in the appendix to this chapter.) The questionnaire was used to structure the interviews but it was not adhered to rigidly; rather, the format was kept flexible to maintain rapport with the respondents. Although some of the interviews digressed greatly and took more than 2 hours to complete, the essential information was obtained in all cases. Interviews were conducted with 39 individuals in five areas of alternative lifestyle concentration in Mendocino County. These areas were identified with the aid of United Stand leaders to provide a cross-section of alternative lifestyle types. Of special importance was the coverage of both inland and coastal areas and communal and individual living arrangements. In two larger communes subjects were chosen at random but in the other areas the individuals identified as being "representative types" were interviewed. Between 5 and 10 individuals were interviewed in each of the 5 areas.

Background information was obtained about the environment, location, land characteristics and dwelling size. Specific questions related to energy use include whether utility-provided electricity and gas serivce is present, what appliances are used in the household, what fuels are used, the amount of fuel used, and the costs (where known). Energy used in transportation was calculated from the replies to the travel questions and types of vehicles owned. Additional information was obtained about farming and gardening activities, other food raising activities, knowledgeability of respondents about alternative energy sources, and additional information about the respondents.

A. Methodological problems and accuracy of the data

We decided to tabulate energy use by household, a decision which poses no special problems for persons living in individual homesteads but does pose problems where communal living arrangements are considered. Fortunately, the situation was not as complicated as might have been the case. In the three larger communes in which interviews were conducted, the members shared communal facilities in a main house, where cooking and other daytime activities took place, but maintained separate private quarters in nearby small houses, which were usually occupied by 1 to 3 persons. We considered these living units as households. Two smaller communes of 6 and 7 persons respectively were treated as households.

To calculate energy use for a household which was part of a commune, we divided the communal energy use (for shared activities) by the total number of households in the commune and added to this the additional amount used by the individual households. For example, in one commune there were 11 households, of which 6 were interviewed. Communal energy use was divided by 11 and the individual amounts used by each of the six respondents were added to the household share of the communal total. For purposes of description, we believe that the average values thus obtained are accurate.

Accuracy of the data. Since most individuals do not keep written records of their energy consumption, some uncertainty is, of course, to be expected. Estimates of propane use are undoubtedly the most accurate because propane is purchased in fixed amounts (usually in 20 gallon tanks) only a few times per year. Estimates of kerosene and gasoline use in the household should be nearly as accurate, since these are also usually purchased in clearly measured amounts, although not always the same amount. Although several respondents were uncertain about their estimates, most were fairly confident in them. We would expect that data on wood use are the least reliable since wood is not generally stacked in cord piles (or some multiple thereof).

B. Results and observations

Utility-provided energy is virtually non-existant among alternative lifestyle individuals. Only 2 of the 39 respondents in our survey buy electricity from the local power company (PG&E). None buys natural gas. These results are consistent with a survey taken by United Stand, which showed that fewer than 5% of more than 350 respondents buy electricity from PG&E (Forrest). There are important economic and noneconomic reasons for the lack of utility-provided electricity. Most people simply cannot afford the hookup charge, which would be a minimum of $2,000 if power lines already exist nearby. Where power lines have to be strung over several miles of rugged terrain the cost would be much higher. The noneconomic reasons include the appropriateness of electricity to the simple lifestyle and the appropriateness of relying on a giant company for an item as essential as energy. Nearly half the respondents said they do not need electric utility service but this does not mean they do not want electricity. Nearly one-third of the respondents now generate their own electricity (for brief periods) by gasoline or diesel generators. From conversations and survey responses it was clear that many people would like to have a more regular (and less noisy) source of electricity than the gas generator, especially those who do extensive work with power tools. The idea of using wind or water power, where possible, seemed highly appealing to many individuals. However, buying electricity from the utility company was seen by some as antithetical to the desire for self-reliance. Moreover, many alternative lifestyle persons see the giant utility company as one of the symbols of the "dehumanizing industrial state" and indicate that they do not want to support the utility company. About one-third replied in terms such as: "We're against PG&E" or "We don't want to support PG&E."

Household Energy Use. Data were obtained for the four major non-human sources of energy, propane, wood, kerosene, and gasoline for household use. The summary results which follow are based on 38 respondents since 1 respondent operated a commercial sawmill and it was impossible to separate his household use from use for the sawmill. Propane is the most widely used fuel for cooking and refrigeration. 56% use propane as the primary fuel for cooking (whereas 31% use wood); 33% have propane-powered refrigerators. In addition, 18% have propane water heaters. Only 3 of the 39 persons interviewed did not use propane at all and in both houses with electricity propane was used for cooking. The range of propane use was quite wide, from a low of 20 gallons per year (for those who used any at all) to a high of 350 gallons per year. 29% used 50 gallons per year or less and 60% used 100 gallons or less. The average use was 107.7 gallons per year, which has an energy content of approximately 10 million BTU. At one of the inland areas, the average use for 10 respondents was less than half that of the average for the total sample. There was virtually no difference between the communal and non-communal categories in propane use.

Wood burning stoves are the universal source of heat in alternative lifestyle households. Many households also use wood for cooking, although in the summertime this can be extremely uncomfortable. It is the availability of wood at virtually no cost that permits the very frugal lifestyle to be maintained. For most individuals, wood for the stove is obtained on their own property and the only costs are that of a chainsaw and gasoline. Even in rather marginal foothill lands there is more than adequate oak and manzanita on a 10 or 20 acre parcel to provide the heating needs of a small house. With a better quality woodlot, a sustained yield of one cord per acre per year should be readily obtainable (Havens). Both attitudes toward wood and the extent of its use vary widely.* 74% of the respondents used 3 cords per year or less. However, 11% used more than 10 cords per year, a very considerable amount in the relatively mild northern California climate. Average use is 3.7 cords per year. Use among communal respondents is somewhat below that of noncommunal, however the difference is not statistically significant. Assuming an average energy content of 30 million BTU per cord of oak** the average household uses approximately 111 million BTU

* Hackett (1977) discusses the variety of attitudes toward wood use.

** Baumeister and Marks (1967, p. 7-19) show an energy content (heating value) of slightly more than 30 million BTU per cord for seasoned oak (12% moisture). The amount of heat energy actually supplied is much lower and depends on efficiency of the stove and flue losses.

per year in wood energy. This is nearly 90% of the total household energy use/supplied by all sources.

All respondents but one--a PG&E customer--use kerosene to light their homes. The range of variation in use is surprisingly large, from 5 gallons per year to more than 100 gallons per year. 55% of the respondents used 20 gallons per year or less, and 74% used 36 gallons per year or less. Communal use is a bit higher than non-communal use although the difference is not statistically significant. The average use is 27.0 gallons per year, which has an energy content of approximately 3.7 million BTU.

Gasoline is used in the household for operating chainsaws and gas generators, which power appliances and shop equipment. All but 2 respondents reported some household use of gasoline. 53% used 20 gallons per year or less, and 82% used 36 gallons per year or less. Communal use of 27.0 gallons per year was somewhat above the average of 23.3 gallons per year.

In Table 2-2 we summarize the annual household use of 4 energy sources for all respondents and for communal and non-communal subcategories of respondents. We also show data for what may be characterized as a frugal sub-group of 10 individuals interviewed at one of the inland communities. Their use is far below average for each of the nonrenewable fuels.

The total average annual household energy use of nonrenewable fuels is estimated at 16.4 million BTU for all respondents. For communal respondents the average is 16.0 million BTU; for non-communal respondents it is 17.1 million BTU. The average cost per household for propane, kerosene and gasoline is estimated at $85 per year.* It is assumed that there is no

* Based on Summer 1976 prices.

Table 2-2. Average Annual Household Energy Use of Wood and Nonrenewable Fuels by Alternative Lifestyle Households

	Wood		Nonrenewable Fuels						
			Propane		Kerosene		Gasoline[b]		Nonrenewable Energy Total[c]
Category	Cords	million BTU	Gallons	million BTU	Gallons	million BTU	Gallons	million BTU	(million BTU)
All respondents (n = 38)	3.7	111.0	107.7	9.85	27.0	3.67	23.3	2.91	16.4
Communal (n = 16)	3.0	90.0	102.8	9.41	31.3	4.26	27.0	3.38	17.1
Non-communal (n = 22)	4.2	126.0	111.3	10.2	23.9	3.25	20.7	2.59	16.0
Very frugal (Mid-Mountain) (n = 10)	3.2	96.0	51.3	4.69	17.1	2.33	20.7	2.59	9.6

[a] Conversion constants used in calculating energy use in BTU are:

Propane: 1 gallon = 0.0915×10^6 BTU
Wood (oak): 1 cord = 30×10^6 BTU
Kerosene: 1 gallon = 0.136×10^6 BTU
Gasoline: 1 gallon = 0.125×10^6 BTU

Source: Baumeister and Marks (eds.), Mechanical Engineers' Handbook, 7th Edition, 1967, pp. 7-19, 7-21

[b] Home use only; includes diesel fuel for generator

[c] Sum of propane, kerosene and gasoline use

direct expenditure for wood. However, the annual cost of the chainsaw (amortized amount) of $15 to $20 per year should be allocated to wood use. Thus, the average annual cost of household energy is slightly above $100 per year per household.

Newman and Day, in their 1973 nationwide survey of energy use, found that the average annual consumption of natural gas and electricity by poor households in their sample was 173 million BTU per household (Table 2-3). However, Newman and Day did not include the energy use for space heating by fuels other than natural gas and electricity. Since only 62% of poor households heat their homes with natural gas and electricity it is important to estimate the energy for space heating provided by other sources. Using other data from Newman and Day*, we estimated that for poor households this amount is approximately 40 million BTU per year, thus giving a total annual household use of about 213 million BTU. Therefore, total energy use (including wood) for household purposes by alternative lifestyle households is about 60% the amount used by the average poor household in the Newman and Day nationwide sample.

The low energy use among alternative lifestyle households is much more impressive if we look at nonrenewable sources--i.e., fuels other than wood. (However, it should be kept in mind that wood is a renewable resource only if the exploitation pressure or densities of exploiting populations is low.**)

* Data from Tables 5-3 and 5-4, pp. 93-94.

** Forests in many parts of the world have been decimated by overexploitation as a result of the dependence on wood for fuel. The ecological and economic consequences have been very serious and promise to become even worse (Eckholm, 1975). A widespread shift to wood as a heating fuel in this country seems unlikely and undesirable. We would expect over-cutting of forests (mostly fir--the least desirable fire wood), rapid price increases, not only for fire wood but for lumber, increased air pollution, and increased damage from chimney fires, a serious hazard, especially if fir and pine are burned extensively.

Table 2-3. Comparison of alternative lifestyle energy use (survey sample) with energy use by nationwide sample by income level (Newman and Day).

	Energy Use (in million BTU's)				
		Nationwide sample[a]			
	Alternative Lifestyle	Poor	Lower Middle	Upper Middle	Well Off
I. Direct Energy					
A. Household					
Natural gas	--	118	129	142	174
Electricity	--	55	81	108	124
Wood[b]	111	--	--	--	--
Other fuels[c]	16	40	33	33	47
Household Subtotal	127	213	243	283	345
B. Transportation					
Gasoline	83	34	85	153	180
Total Direct Energy Use	210	247	328	436	525
II. Indirect Energy[d]	150-200	353	549	831	1095
Total Energy Use	360-410	600	877	1267	1620

[a] Newman and Day estimates (p. 90), except for "Household--Other fuels" (see note c).

[b] Data on wood use not available for nationwide sample

[c] Consists of propane, kerosene and gasoline for alternative lifestyle sample and primarily heating oil for nationwide sample. For the Newman and Day sample, the values listed for "other fuels" were estimated by this author based on Newman and Day data in Tables 5-3 and 5-4 (pp. 93-94).

[d] Alternative lifestyle value estimated by author.

The use of nonrenewable fuels for household activities is less than 10% of that used by non-alternative lifestyle households. Furthermore, there is virtually no demand placed by alternative lifestyle households on electrical generating capacity.

Automobile Ownership and Transportation Energy Use. The people we interviewed are highly mobile. Motor vehicle ownership and use is extensive, with an ownership rate of more than 1.5 working vehicles per household (there are many more non-working vehicles which are used for parts). "Old is beautiful" among this vehicle population--74% are more than 10 years old and 17% are past 20 (average age is 14.5). Pickups and other trucks (flatbeds and vans) outnumber sedans (mostly Volkswagens) by a wide margin. We also counted several motorcycles. Trips to town are frequent and longer journeys to visit friends and obtain materials in the San Francisco area and Central Valley are occasional--4 to 6 per year is typical. The average mileage driven per household was 9,970 per year. 64% drove 10,000 or less but 15% drove more than 20,000 miles. Based on the assumption of 15 miles per gallon,* an average of 665 gallons of gasoline per year with an energy content of 83.1 million BTU is used. Except for a few individuals and one large commune there was little indication of thought given to reducing travel, especially where regular shopping trips are concerned. A commune at which trips are coordinated reported a total mileage of 23,000 for 23 people (11 households). Energy use for transportation for our sample is comparable to that of lower middle income households in the Newman and Day survey (Table 2-3) and is approximately 2 1/2 times that used by poor households. However, it is still well below that of upper middle and well-off households.

* Approximate average for the observed age distribution.

Indirect Energy Use. Much of the energy used in our society is not consumed in the household or in personal transportation but goes into the production and distribution of the goods and services that we consume. It is, therefore, appropriate to attribute this form of energy use to the individual and denote it as "indirect use." When we consider the energy input to the production of automobiles, food, housing, appliances, and fuel, it should not be surprising that most Americans consume much more energy indirectly than directly (Newman and Day, p. 90; results reproduced in Table 2-3 of this chapter).

The major sources of indirect energy consumption by alternative life-style households are the automobile, food, and housing; appliances and home furnishings are of lesser importance. We made rough calculations of the indirect energy use of alternative lifestyle households for food, the automobile, and appliances and found that food and automobile use are the major contributors and appliance use is negligible.

To estimate the energy input to food, we first estimated that the average adult consumes 3,000 kcal. per day, which translates to 4.34 million BTU per adult per year. The average household size in our survey was 2.77 and the composition was about 25% children. Assuming children consume 1500 kcal. per day, the average household consumption is 10.55 million BTU per year. To make the leap from food energy consumption to the energy input to produce that much food, we examined the national aggregate data of Steinhart and Steinhart (1974) and guessed where alternative lifestyle persons stand with regard to the typical American household.

The energy input to food varies tremendously, depending on the amount of equipment used to produce and process it, the fertilizer and pesticides used to grow it, the amount of irrigation, the kind of packaging, and the distance it was transported. Where meat is concerned, the energy input to cattle feed is a major energy consumer, with feed-lot cattle at the top end of the energy subsidy scale (more than 10 calories of energy input is required to produce 1 calorie of feed-lot beef). Steinhart and Steinhart (1974) show that the energy subsidy--the ratio of calories of energy input per calorie of food energy output--has increased from about 2.5 in 1930 to more than 9.0 in 1970. However, this ratio includes energy for home refrigeration and cooking. After removing refrigeration and cooking, which is counted as direct energy use, the 1970 subsidy ratio is 7.5.

There is no doubt that the energy subsidy ratio for alternative lifestyle households is much lower than the national average, for several reasons. They grow a portion of their own food (one-quarter to one-third, on average) which requires much lower energy input than commercially produced food because of less transportation, less processing and packaging, less fertilizer and pesticides, and hardly any mechanized equipment. When they buy food, they try to buy unprocessed foods in bulk (no fancy packaging) from nearby producers. More importantly, many are vegetarians and the average meat consumption--a high energy subsidy food--is very low. Because of these radically different food consumption patterns we estimate that their indirect energy consumption from food is less than 50% of that for the typical American household, which means an indirect energy subsidy ratio of 3.75 or lower. Using a ratio of 4.0 (to be on the conservative side) we obtain 42.2 million BTU per household per year as the indirect energy use for food.

Most of the automobiles owned by alternative lifestyle households are old and many would have been relegated to the junk heap if not salvaged by their present owners. Only 26% of the vehicles in the sample are less than

10 years old and 40% are more than 16 years old. The average age is 14.5 years. Thus, the amount of indirect energy attributable to these vehicles (from manufacture) is very small, since most of their useful life was over at the time of purchase (at least, if compared to the average vehicle life in the general population). Probably, only about 10% of the energy used in manufacture and for other overhead items should be charged to this vehicle population. Using the data of Hannon, et al. (1975, pp. 117) this component of energy use is approximately 3 million BTU per vehicle per year. The indirect operating energy, which is attributable to fuel production and distribution, maintenance and repair, and street construction is about 25 million BTU per vehicle per year. Thus, for an average household with 1.5 vehicles, the indirect energy use is about 42 million BTU per year.

The number of appliances owned is much smaller than for the average U.S. household and even than poor households nationwide.* The few appliances and furnishings are generally old and many would have been discarded if not salvaged by alternative lifestyle people. Thus, as with automobiles, only a small fraction of the energy input to production of these items should be counted as indirect energy use by these households. Even if we assume that the life of the appliances is not extended by alternative lifestyle households, the indirect energy use would only be about 2 million BTU per household per year.**

Because houses are small and use a large proportion of recycled lumber and other matter and contain little or no insulation, very little electric wiring or plumbing, very simple heating systems, and no air conditioning, we would expect the indirect energy attributable to housing to be very low.

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* See Section 2.6 for data on appliance ownership by alternative lifestyle households and Newman and Day (p. 98) for nationwide data.

** Estimated based on data from Herendeen and Sebald (1975, p. 135).

With housing considered, the indirect energy use is perhaps 100 million BTU per year. To be on the safe side, in accounting for other uses, we add another 50-100 million BTU, thus giving a reasonable guess of indirect energy use of 150-200 million BTU per year per household. This is approximately one-half the amount used by poor households nationwide and less than one-quarter of that used by upper middle income households.

2.5 Economic Considerations

A. Self-sufficiency

Many back-to-the-land people have taken care of their shelter needs and are trying to produce a significant proportion of their food supply but very few come close to meeting food needs on the homestead. Of those surveyed, only 10% produce more than 60% of their food in the summer and 5% produce that much in the winter. The median percentage of food requirements produced on the homestead was about 30% in summer and 15% in winter, which clearly indicates that the typical back-to-the-land household is a long way from being self-sufficient. A part of the reason for the relatively low level of food production is the generally low quality of land and the limited water supply.

With respect to other goods and services, there seems to be little effort to establish economic self-sufficiency. Considerable automobile maintenance and repair is performed at Mid-Mountain and other locations and it is likely that this is one of the community activities that reduces reliance on the cash economy. Activities such as bartering and procurement of recycled materials are prominent. Nevertheless, there does not appear to be adequate specialization or cooperation needed to establish a viable non-cash economy within the community. This is a point which the Nearings (1954) addressed at some length, noting with sadness that their efforts to establish a self-sufficient economic community in Vermont was a dismal failure, largely because of the independence of the old-time residents. With respect to the provision of educational, medical and legal services, and the technology that is required for construction and food production, it appears that self-sufficiency at the level of a small community is an unrealizable goal.

B. Income: Sources and Amount

Since self-sufficiency is unrealizable, back-to-the-land persons are necessarily dependent on the cash economy. Sources of income include wage-paying jobs, various entrepreneurial activities, and transfer payments received from government and other benefactors. All of these sources are ultimately dependent on the cash economy. The people of Mid-Mountain, for example, are active participants in the cash economy of the Ukiah-Willits area. Men frequently work at construction jobs as carpenters and plumbers, at farm or ranch jobs, or at garages/service stations. Women work in the grape vineyards tying vines and presumably at other farm/ranch jobs. The pay is approximately $5 per hour for construction work and $3 per hour for farm/ranch work. People frequently commute to Ukiah two or three days a week, but they generally do not work any more than they need to. Some stay in Ukiah for extended periods in winter but construction related work is less likely to be available then. Work is likely to be sporadic and seasonal, and certainly does not average as much as 2 or 3 days per week throughout the year for most persons. In fact, we learned that several people are very concerned about the lack of employment and expect difficult times ahead even though many have established themselves as reliable and skilled workers and indicated that they were in demand for construction and ranch type jobs.

Cottage Industry. We did not see much evidence of thriving cottage industry among the persons surveyed. However, several projects were in their formative stages at the time. One individual was hoping to obtain a small grant from the state to expand his capacity to build looms. Another person is raising worms and has built more than a dozen large bins, each holding more than 100,000 worms, in what was formerly the garden area. This person is optimistic about the money-making possibilities of selling the worm castings as fertilizer and also selling the worms themselves. One of the communes had plans for operating an auto parts business and for selling houseplants which they grow in their large greenhouse. The hopes of two years ago have not been attained although apparently some houseplants are being sold (Hackett, 1976). This commune also sells produce from its large and successful garden. A more innovative money raising scheme was tried recently by a commune which held a retreat for a small number of professional people from Los Angeles. There are undoubtedly additional opportunities along these lines, for example accepting paying guests who are interested in learning more about alternative lifestyles firsthand, but these activities entail a loss of privacy and may be in conflict with the lifestyle goals of the commune members.

In comparing his observations of one commune to those obtained two years earlier, Hackett (1976) notes that there is now a much greater concern with economic issues. The desires of the commune members at this time to have items such as an operating sawmill, a tractor and truck, and other equipment reflects their feelings about how to function more effectively as a production unit in contrast to the more philosophical concerns of two years ago, which emphasized how their activities were compatible with their values. These practical concerns undoubtedly indicate some dissatisfaction with their inability to develop any thriving enterprises at the commune and the frustrations caused by equipment breakdowns and other problems. It may also indicate dissatisfaction with dependence on the agricultural wastes of the larger society, as members of the commune travel to the Sacramento Valley annually to obtain tomatoes and fruit which are left after the harvest.

Respondents were asked for their income and sources of income, and most replied willingly but we cannot say with what accuracy. In most, but not all, cases the figures are individual rather than household income. 56% reported incomes of less than $100 per month (28% reported no income at all). Approximately 3/4 are below the official poverty line for 1 and 2 person households (for urban residents). Only 2 persons reported incomes above $400 per month and these were very large, falling within the top 5% of all U.S. households, although there is reason to believe that in one case an annual income was mistaken for a monthly income.

About 10% of the respondents reported receiving social security disability payments and another 10% unemployment insurance payments. Nearly 1/3 were receiving food stamps but none reported being on welfare (AFDC). Conversations with several persons indicated that the receipt of AFDC payments is not entirely unknown among alternative lifestyle households but a survey taken by United Stand found that only about 5% of respondents were receiving welfare payments. Another form of income (in-kind) comes from the use of public medical facilities without payment or with partial payment under the Medi-Cal program. Some persons have been treated for serious problems at the University of California Medical Center in San

Francisco, where they have received high cost care at virtually no cost to themselves. It is not known to what extent the transfer payments from government agencies and gifts from families and friends were included in the reported income figures but it is reasonable to suspect that most were not reported.

C. Expenditures

It is possible to live very cheaply in the hills. We were told that two people could maintain their simple lifestyle on as little as $35 per month. However, if they had more they would usually spend it. $35 per month might might cover food and other bare essentials but few people are spending that little. Those who are land owners (many are) have monthly payments which typically run from $75 to perhaps $150 per month and these are the greatest financial burden to many of the respondents. Land prices were said to be in the neighborhood of $500 per acre in the hilly and low quality inland areas, which represents a rapid increase in price from about half that level four years before. Thus, the typical 20 acre inland parcel is selling for approximately $10,000. In coastal areas, land prices are much higher, in the neighborhood of perhaps $2000 to $4000 per acre. Other significant and necessary costs include automobile purchase and maintenance as well as the purchase of gasoline. At a place like Mid-Mountain, which is approximately 4 miles from paved road on an extremely rough and sandy dirt road, automobile maintenance may be quite expensive. One person said that a Volkswagen engine will last about a year, because of the excessive amount of dust that enters the engine. He said that when an engine is worn, he might replace the entire car with another old car, or else repair or replace the engine. This expenditure would almost certainly cost several hundred dollars per year. Most respondents noted that automobile repair and maintenance is frequent and is costly even though most of the maintenance is done by the owners or their friends. We would expect maintenance and repair to cost the average household at least $200-$300 per year. Moreover, the cost of gasoline for the average amount of driving per household amounts to more than $300 per year.

It was observed by Kern, et al., that the owner-builder is continually making improvements to his or/her home. Our survey and Kern's data also indicates that the average residence time in an owner-built home is low. Many persons go on to a second and third home in a fairly short period of time. Two of the people interviewed were living in the fifth home which they built themselves. Even though the homes may be very inexpensive,* there could be considerable outlay in any year for improvements or for building a new structure. The expenditures for home building and improvement are probably not included in the estimates of expenses which were obtained by our survey.

Expenditure data obtained in the survey should be treated as a rough estimate. As with income, it was not clear in several cases if the respondent reported individual or household expenses. Where household expenditures were reported we divided by the number in the household to obtain individual expenses. If there was doubt, it was assumed that individual expenses were reported.

Reported expenditures were very low, as one would expect from the low income levels. Five respondents said they spent nothing at all, 62% spent less than $100 per month, 75% spent less than $200 per month and 90% spent less than $300 per month. One commune reported expenses of $800 per month for 23 people (13 adults), which is less than $75 per month for each of the 11 "households" in the commune.

* See Section 2.6 for data on housing costs.

D. Impact on the Economy

By hiring out as part-time workers alternative lifestyle people provide a flexible and relatively low paid labor supply which is invaluable to seasonal industries, especially construction, farming and ranching, and food processing. In this manner, back-to-the-land persons may be filling a role in the economy that has typically been filled by other poor people. However, because of their homestead base and considerable independence they do not feel themselves to be exploited or oppressed. Clearly, the widespread feeling is that they do not have to work if they do not want to and are in control of their lives.

It is quite difficult to estimate what the net impact of the back-to-the-land movement is on the economy. Again, one would have to answer the hypothetical question of what would back-to-the-land persons be doing if they were in a different setting. Some would, no doubt, be working at steady, higher paying jobs and others would be unemployed. Because the economy is operating at a high level of unemployment the availability of additional people in the labor supply in urban areas would very likely cause others to be unemployed, or at least less fully employed. By reducing their participation in the labor force, in certain job categories, they are increasing the opportunities for others. However, as a result of their choice, they are competing in the labor force with certain categories of workers, especially in construction trades, and therefore may have a detrimental effect on these groups. In most areas, the organization of building trades is so powerful that journeymen construction workers are not likely to be in danger of losing part of their livelihood. The result is probably to reduce the number of new entries as journeyman in the construction trades.

However, in Mendocino County the building trades are not unionized and it is quite likely that the increased labor supply has hurt older residents employed in these job categories.

Although most alternative lifestyle people are living below the officially defined poverty level for urban residents, most of those surveyed are satisfied with their lifestyle and do not see themselves as living in poverty. They feel that they are living the good life and are demonstrating that it can be done with very small cash incomes. Certainly, the demeaning effects of poverty that are generally observed in urban areas are not anywhere in evidence.

2.6 How People Live

Housing. For many alternative lifestyle people, the provision of housing has become a more important activity than even the production of food. Building a house evidently affirms one's ability to be self-reliant in a way that growing food does not. Kern, et al. comment that "...Building a house is often described as one of the most fulfilling experiences of one's life. The gratification of learning so many new things, the satisfaction of creating with one's own hands, and the excitement of seeing the spaces evolve, help to compensate for the long hours of hard work." (Kern, et al., p. 85).

Most houses are small and rustic looking but they are generally well designed and aesthetically and functionally pleasing. The diversity of design is great, reflecting the personality, architectural ability and budget of the owner-builder. Many houses evolve through a series of additions which reflect the very high importance attached to, and the pride taken in, the provision of shelter. Oakland architect James Aitken, a member of the State Commission of Housing and Community Development examined owner-built housing prior to the vote of the Commission on Class K housing.* Aitken commented: "Two days of marching through the hills of Mendocino County to take a look at some of these places convinced me that they are very fine homes...Some are works of art." (Sacramento Bee, July 24, 1976; p. A-3)

To the urban dweller burdened by large house payments or rents, the cost of alternative lifestyle housing is startling. I visited one house of about 400 square feet which was built 5 years ago at a cost of under $100. It is still in good condition and should be serviceable for quite a few more years. Of the houses included in our survey, for which cost information was available, half cost $500 or less and 75% cost $1000 or less. Only 12.5% cost more than $3500. There were 2 expensive houses in our sample, one costing $12,000 and another costing $21,000 but these are quite unusual for alternative lifestyle housing.

The remarkably low costs are achieved in several ways. Most houses are built from used lumber and other parts which are frequently salvaged from demolished buildings. Some owners cut trees on their property and have them milled locally at low cost. Since the Uniform Building Code requires the use of graded lumber (i.e., new lumber that receives a stamp of approval) as well as indoor toilets and electricity, most alternative lifestyle houses do not conform to the building code. Other, lesser cost savings compared to houses which meet the building code are achieved by the use of an outdoor privy, usually a simple pit but more often of late a compost privy, rather than a flush toilet and septic tank, which costs

* Class K refers to rural housing which does not conform to the Uniform Building Code, which contains Classes A through J. The Commission voted to encourage local governments to permit such housing but left the final decision to local government.

several hundred dollars. However, the major cost saving comes from the labor provided by the owner-builder and friends, which in most cases is very considerable. Strict adherence to the building code would require a minimum expenditure of approximately $5 per square foot of house, according to an accounting provided by Kern, et al., whereas most of the non-code houses of 600 square feet or less were built for less than $2 per square foot.*

Our survey data shows an average house size of approximately 570 square feet with 41% of the houses below 400 square feet and another 33% between 400 and 600 square feet. Only 13% of the houses are larger than 900 square feet. It is interesting that Kern warns the prospective owner-builder not to build too small a house, which he notes is a characteristic problem.

From replies to questions about how long it took to construct the house and how many people worked on it, we made rough estimates of the number of hours of labor that went into the construction of the house. These estimates are subject to considerable error since the number of persons working on the house and the amount of time each worked was likely to be quite variable. It appears that reasonably experienced individuals can generally build a house of approximately 600 square feet with about 1000 to 1500 hours of labor. One house, which was built by experienced owner-builders and several friends working intensely over a one month period, took approximately 700 hours. Few houses are built in such a short time span--many take more than a year of less intense effort.

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* Kern et al., p. 93 shows costs per square foot (for 21 houses) increasing considerably with the size of the house.

Appliance Ownership. As already noted (Sec. 2.4) the ownership of household appliances is extremely low. The only appliances in widespread use are the woodburning stove, the rangetop, which in some cases is the top of a woodburning stove, and the radio. Only one respondent indicated no rangetop for cooking. Access to an oven for cooking was also widespread. In reporting appliance ownership, it is also important to note that access to appliances is much greater than the number of appliances because of communal ownership. For example, among the 39 households surveyed there are 19 ovens but 26 households have access to ovens; there are 17 refrigerators but 24 households with access to refrigerators, and there are 6 washing machines but 9 households have access to them. Among poor households in the Newman and Day survey, 98% own refrigerators, 95% own stoves, 23% own food freezers, 62% own washing machines, 24% own clothes dryers and 94% own television sets (Newman and Day, p. 98). In our sample, 77% own radios, 38% own tape recorders, 13% own stereo equipment and 10% own television sets. Most of these are battery operated. These ownership figures are far below those for the general population, even among poor households. As a result of this low rate of appliance ownership, it is not surprising that the energy use for household appliances is far below that of the general population. We estimate that approximately 15 million BTU per household per year, from fuels other than wood, is used for appliances. This includes the entire amount of propane plus 20% of gasoline use--the amount used for powering washing machines (from the gas generator). In addition, some wood is used for cooking and water heating. In contrast, Newman and Day reported average annual household energy use for appliances of 51 million BTU (p. 60).

Activities. Respondents were asked what home production activities they engage in and how much time is devoted to each. Since activities vary from day to day and week to week, we cannot expect an accurate accounting of time spent, but only an indication of which activities are relatively frequent and which are not. We asked specifically about crafts, building things, gardening and raising animals, and maintenance.

One-third of the respondents engaged in crafts activities but the time spent by most was less than 2 hours per day, on average. About the same fraction was involved in building and maintenance although the time spent was greater than in crafts. 41% said they spent time raising things, however, it is possible that many respondents interpreted this question as referring to animals but not gardening/farming, as the response should have been much higher if gardening were included (approximately three-fourths of the respondents produced more than 10% of their food needs by gardening). Also, it is probable that many respondents did not include time spent in building houses and in auto maintenance and repair, both of which are major activities for many of the males.

Water Supply. Water supply can be a problem in summer and careful water management is essential, especially if a large garden is cultivated. Most of the respondents obtain their water from springs, which vary greatly in the amount they supply and their reliability. A few springs become dry or nearly so in summertime but most provide adequate water to their frugal users. Typical flow rates are from 100 to 500 gallons per day but some flow at several thousand gallons per day. Most houses have water piped from the spring by gravity feed to the kitchen sink, sometimes through a water heater. Flush toilets and showers are rare so plumbing is kept simple. Gardens take most of the water as household use is very low--mainly for cooking and dishwashing. Most people store small amounts of water (from several hundred gallons to 10,000 gallons) either in steel drums, wooden tanks, or plastic swimming pools. At Mid-Mountain, where the fire hazard in summer is very high, a number of plastic swimming pools are used for storage. Wells are not widely used because most homesteads do not have existing wells and it is very expensive and risky to drill new ones. Many existing wells have dried up or produce very low flows and low quality water in the summer.

Waste Disposal. Until recently the outdoor pit privy was the common method of human waste disposal. Interest has been growing in the compost privy, due in large measure to the work of the Farallones Institute and United Stand in developing and disseminating information.* In our sample, 23 of the 39 respondents use pit privies, 10 use compost privies, 3 have indoor toilets and septic tanks, and 3 use other methods. Many of those using pit privies indicated an intention to construct a compost privy, which requires two chambers, which are alternately filled and allowed to compost.

The method of waste disposal has important psychological (i.e. life-style) and political implications. For those persons concerned with living in harmony with nature (and there are many) the recycling of composted human waste is extremely appealing--much more so than filling and sealing a pit or flushing a toilet, which not only wastes precious water and sometimes causes contamination of water, but also removes the "wastes" from view. Excreta is then not thought of as waste to be disposed of, but as a resource with which to enrich the soil. My impression is that attitudes

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*See, for example, United Stand, "Privy Booklet (and Greywater Systems)," P.O. Box 191, Potter Valley, CA 95469.

toward what one does with one's excreta has considerable symbolic importance to back-to-the-land persons.

The political implications of waste disposal methods can be significant, since the absence of flush toilets is perhaps the most visible and often cited violation of the Uniform Building Code. Efforts to oust Mid-Mountain residents from their homes in 1974 because of building code violations were met by the organization of alternative lifestyle people throughout the county (United Stand) and successful court suits which blocked the county's effort. Early in 1976 the County passed an ordinance to permit compost privies on an experimental basis but required that the house have a flush toilet as well. Only a handful of permits had been issued as of July 1976 and most alternative lifestyle housing continues to violate the building code.

<u>Health Issues and Other Problems</u>. As noted, the most politicized health issue has been the hazard of outdoor privies. These appear to have been overstated by opponents of the alternative lifestyle and understated by proponents. Dr. Craig McMillan, the Director of Public Health for Mendocino County, believes that privies in rural areas do not pose a special public health hazard. He commented that if people know what they are doing there should not be any problem but if they don't or are sloppy in their personal sanitation there could be problems (McMillan, 1976).

One of the most knowledgeable persons surveyed indicated a concern about hepatitis and trench mouth because many persons are not aware of the hazards of improper practices. Hepatitis was mentioned by about one-fourth of the respondents, but more as a concern than a current problem. The general impression is that health is good. Although it was not mentioned frequently, several persons indicated that back problems caused by lifting very heavy objects are common and sometimes serious.

The primary problem mentioned by alternative lifestyle persons is money, or, more accurately, the lack thereof. For many it is difficult to generate adequate income and to reduce expenses to match their often meager income. Employment is very sporadic and jobs are not easily obtained. Several voiced unhappiness at their dependence on the outside world as a result of falling far short of self-sufficiency, especially with respect to food production and more generally their inability to generate income by producing marketable goods or services.

Another problem mentioned prominently is the lack of skills necessary to live the alternative lifestyle successfully. One respondent said, "You need lots of research to live this lifestyle." Others mentioned isolation and boredom, government (laws and building codes), and communication with others as important problems. Difficulties of living in a group and too much time spent in problem solving were extremely important to commune members--a finding that is not surprising in view of the research of Kanter (1972) and others of the sometimes immobilizing effects of democratic decisionmaking.

2.7 Appendix: Survey Questionnaire

Date ______________________

No. ______________________

ENERGY SURVEY

I. Type of Residence and Physical Environment

1. Name of settlement ______________________
2. Location of residence ______________________
3. Physical environment:
   a. Location (distance from towns) ______________________
   b. Ecosystem ______________________
   c. Quality of land for farming ______________________
   d. How much is usable as pasture __________ for crops __________
   e. Altitude ______________________
   f. Terrain ______________________
   g. Vegetation ______________________
4. Approximate size of dwelling ______________ sq. ft.

   (or __________ ft. by __________ ft.)
5. Number of rooms (not counting bathrooms) ______________________
6. When was the building of the house begun? (i.e. age of house) __________

   ____
7. Land:
   a. Own __________ Rent __________
   b. Who owns it? ______________________
   c. Where are owners? ______________________
   d. Number of acres ______________________
8. House:
   a. Own __________ Rent __________
   b. Who owns it? ______________________
   c. Where are owners? ______________________

9. Number of people living in the house ____________________

10. Age of people living in the house ____________________

11. Year round resident: Yes _____ No _____

(Or note if used as second home or other periodic use. ____________________)

12. If not, where do you live most of the time? ____________________

13. How long have you lived in this area? _______ Same House? _______

Nearby ____________________

14. How long do you expect to live here? ____________________

15. Where will you go? ____________________ When? _______

16. Brief biography ____________________

II. Energy Use, Awareness and Attitude

17. Do you have electricity supplied by an utility company? Yes ___ No ___

18. Do you produce your own electricity? Yes ___ No ___

a. Source ____________________

b. If gas or diesel generator, what size, i.e. power output?

____

19. Do you have natural gas supplied by the utility company? Yes ___ No ___

20. Do you use:

	Yes	No	Purpose
a. propane	___	___	___
b. kerosene	___	___	___
c. gasoline	___	___	___

21. Home is heated by: (indicate primary and secondary sources):

a. Central furnance, using: Gas ______ Fuel oil ______

b. Room heater, using: Gas ______ Electricity ______

Indicate how many ______

c. Fireplace ______

d. Woodburning stove ______

e. Other ______

22. Alternatives to heating home considered? ______

______

23. Fuel(s) used for cooking: (Indicate if different for winter and summer):

a. White gas ______

b. Propane ______

c. Electricity ______

d. Woodburning stove ______

e. Fireplace ______

24. Water is heated by:

a. Stove

Wood ______

Propane ______

b. Fireplace ______

c. Electric water heater ______

d. Gas water heater ______

e. Woodburning water heater ______

25. Alternatives to heating water considered? ______

26. We would like to get an idea of how much fuel (energy) you use in your household for things like heating, cooking and operating other household applicances (including chain saw, water pump).

Fuel	Amount
a. Electricity	________
b. Natural gas	________
c. Propane	________
d. Wood	________
- size of stove ________	
- BTU rating of stove ________	
e. Kerosene	________
f. Gasoline	________

27. Appliances in dwelling (indicate source of power):

a.	None ________	________
b.	Range top ________	________
c.	Oven ________	________
d.	Refrigerator ________	________
e.	Radio ________	________
f.	T.V. ________	________
g.	Clothes Washer ________	________
h.	Clothes dryer ________	________
i.	Vacuum cleaner ________	________
j.	Dishwasher ________	________
k.	Stereo (record player) ________	________
l.	Tape recorder ________	________
m.	Power tools ________	________
n.	Water heater ________	________
o.	Chain saw ________	________
p.	Lamps ________	________
q.	Other ________	________
	________	________
	________	________
	________	________

28. Is a water pump used: Yes _____ No _____

Source of power ______________________________

Purpose:

drinking _________

irrigation _________

washing (incl. bathing) _________

cooking _________

other _________

____

____

29. Main household activities that use non-human energy: _______________

cooking _________

listening to radio/stereo _________

reading _________

bathing _________

other _________

____

____

III. Energy Awareness, Attitudes

30. If no electricity hookup:

a. Do you plan to hook up to electric utility service? _____________

Why/Why not? ______________________________

b. Would you like to generate your own electricity (other than by gas generator)? Yes _____ No _____ Why? _____________

(i) What kinds of methods would you consider? _____________

____

____

c. Information sources: ______________________________

____

____

d. Have you experimented with the production of electricity? ________

(Environ-Attitudes)

31. Source of water:

a. Spring ____________ Quantity or flow rate: ____________

Outdoor (garden) ____________

Indoor ____________

____________ ____________

____________ ____________

b. Well ____________ ____________

c. Other ____________ ____________

32. Do you store water? Yes ____ No ____ Amount ____________

How (incl. pastic jugs)? ______________________________

33. Health problems in area ______________________________

____

34. Do you cut live or dead wood? ____________ Where? ____________

Why? ______________________________

35. How do you dispose of gray water? ______________________________

____

a. Temporary ____________ Permanent ____________

b. If temporary, alternative to present system considered: ________

____

36. How do you dispose of other human wastes? ____________

a. Temporary ____________ Permanent ____________

b. If temporary, alternative to present system considered: ________

____

37. Views toward "recycling systems" (e.g. compost privy, outdoor toilet).

____

____

IV. Transportation

38. Please list the make and model year of automobiles owned by people living in the dwelling (include trucks and motorcycles):

Auto #	Make	Model Year	Type of car/truck (sedan, pickup)	Miles/year.
1				
2				
3				
4				
5				

39. Where do you usually shop for food: _______________

How often? _______________

40. a. How often did you go into town (for all purposes, including work) in the last two - three weeks?

Name of Town	# of times/month	Mileage

b. How does this compare with the rest of the year (i.e. typical or atypical?)

41. Where do you shop for clothing, hardware, other household items?

Town:	How often:

42. Who does auto repair? ____________________

43. Location of auto repair: ____________________

44. Amount and frequency of auto repair: Major ________ Minor ________

V. Food Production

45. a. Do you produce any of your own food? Yes ________ No ________

b. Hunting and gathering? Yes ______ No ______ What? ________

____

c. Home agriculture (subsistence)? Yes ______ No ______

d. Commercial? Yes ______ No ______

Purchase ____________________

Sell ____________________

Barter ____________________

46. Percentage of your own (or your community's) food needs produced:

Summer ____________ Winter ____________

47. Kinds of food produced:

Vegetables ____________________

Fruits ____________________

Dairy products (eggs, #/day ________; milk, qts./wk. ________;

cheese ________)

Meat, fowl ____________ lb/yr.

48. a. Size of garden (give dimension): ___ft. x ___ft. (or _____ sq. ft.)

b. Garden:

Completely communal ________

Partially communal ________

Individual garden plots ________

No garden plots ________

c. Number of people who regularly obtain food from the garden: ________

d. Do you eat together? Yes _____ No ________

How often (Regularly or periodically)? ________________________

49. Do you grow crops such as wheat, oats, barley? Yes ____ No ________

Type of crops: ________________ Amount: ____________ (acreage)

________________ ____________

________________ ____________

50. Number of food producing animals owned:

Type ______________________ Quantity ____________________

______________________ ____________________

51. Do you have any other farm animals? ______________________

____

52. How much feed do you buy in a year? ______________________

53. Kind(s) of fertilizer used: ________________ Amount: ____________

a. If manure, where do you get it? ______________________

54. Methods of pest control used:

a. In garden ________________________________

b. Around home ________________________________

55. Equipment used in gardening or in tending animals:

________________ ________________ ________________

________________ ________________ ________________

56. What other equipment would you like to have:

a. For garden ________________________________

b. For non-agricultural purposes ______________________

____

57. Method of irrigation used in garden: ______________________

____

58. Time lived in a "rural" area: ____________________

59. Where did you live before moving to a rural area? ____________________

____

60. Did you grow food before moving to a rural area? Yes ____ No ____

Amount ____________________ How Long? ____________________

61. How did you learn to farm/garden:

a. Books ____________________

b. Common sense (intuition) ____________________

c. School (Indicate high school, college, other) ____________________

d. "Experimental work" ____________________

e. Friends/neighbors ____________________

62. Present sources of information about farming: ____________________

____

63. Best sources of information for growing food: ____________________

____

64. a. Amount of food preservation: ____________________

b. Amount of food dried: ____________________

VI. Home Activities

65. Did you build your present home? Yes ____ No ____

If not, who built it? ____________________

66. If yes, length of time to build home: ____________________ months

a. Number of hours/day worked during that period: ____________________

b. Number of people that helped with the building: ____________________

67. Cost of home: ____________________

68. Sources of home building materials (i.e. where did you get the materials):

Wood (structural) ____________________

Wood (siding) ____________________

Other ____________________

69. Building techniques used:

Foundation/support: Wood post __________ Concrete pile __________

70. Implements/machine used in construction:

Sawmill __________

Chain Saws __________

Other power saws, drills, etc. ____________________

____

71. Estimate gasoline used in gas generator during building __________

72. Estimate gasoline used in chain saw during building __________

73. Work type activities done at home:

Type	Hours per day
Crafts ____________	____________
Building things ____________	____________
Raising things ____________	____________
Other ____________	____________

74. Time spent working at home, in fields, maintenance, household: __________

____

75. Cash income producing work over last year:

Where? ____________________

What type of work? ____________________

76. Recent trading or bartering experience (indicate nature and frequency of trade): ____________________

____

____

VII. Personal

77. a. Married: Yes _____ No _____

b. Do you plan to be married? Yes _____ No _____

c. Why? _____

78. a. Children: Yes _____ No _____

b. Do you plan to have children? Yes _____ No _____

c. Why? _____

79. Do you have a will? Yes _____ No _____

80. What will happen to the land when you pass away? _____

_____

81. Expenses/month _____

82. Income/month _____

83. Governmental assistance:

a. Disability: _____

b. Food stamps _____

c. Unemployment _____

d. Welfare _____

e. Grants _____

f. Other _____

84. Do you see yourself as using little energy, modest amounts, or quite a bit, compared to the average Californian? _____

85. a. What are the different types of living arrangements (or lifestyles) that exist in this area? (What are the boundaries of the area where these lifestyles are in?) _____

b. How do you fit i [illegible] _____

c. What are the different types of living arrangements (or lifestyles) based on energy consumption that exist in this area? ______________

____

d. How do you fit in? ______________________________

86. Do you have any special philosophy about your relationship to the natural environment?

87. What do you see as the major difficulties in living this lifestyle?

____

____

Chapter 3. New Towns and Energy Efficiency

3.1 Introduction

Although new towns offer the possibility of reducing energy consumption significantly, most have not been designed with energy efficiency in mind. This chapter presents an overview of the new towns movement, looks at the rationale for new towns, examines some of their failures and successes, and reports on the progress of one new town, Cerro Gordo, which is designed to reduce energy and resource consumption.

Characteristics of New Towns

The New Communities Council has identified the elements necessary for a development project to be classified as a new town (community).[2] Planning for the new town must reflect consideration of social, economic, physical, and governmental aspects of the new community development program in accordance with the following broad objectives:

Governance. Provision should be made for residents to become involved in the organization and operation of the new community, both on neighborhood and community levels.

Social. The community should be planned to encourage interaction of different social, economic, age and racial groups to the maximum extent feasible.

Economic. A primary objective should be the provision of a wide range of employment opportunities so that new community residents can work in the community. Housing should be priced so as to accommodate households with a wide range of incomes.

Physical. The physical environment should be designed to human scale, and arranged to promote a personal sense of identity within the community.

It should reflect a commitment to aesthetics and preservation of the natural environment. (Griffin, 1974, page 3).

A new town is a fully planned development that is implemented over a predetermined time period and includes a balance of social services and activities--industrial, commercial, recreational, educational--characteristic of a fully developed city. However, its objectives in the areas of citizen participation in governance, in interaction of members of the community, and the provision of housing for a wide range of income and social groups are loftier than those generally held by most cities.

Planned cities are not new. Campbell (1976, p. 19) traces the history of planned cities to the 4th century B.C. to Miletus, Greece, and through the Middle Ages when many new towns were created in England, Switzerland, and Germany. Comprehensively planned communities can also be traced to the earliest days of village development in New England. Two colonial capitals, Annapolis and Williamsburg were developed according to the planning principles popular in Europe at that time. New towns sprang up in great numbers as the country expanded westward but these were generally planned by land speculators and railroad companies and are not outstanding examples of planned communities (Griffin, p. 4).

The modern new town movement was strongly influenced by Ebenezer Howard, whose "Garden Cities movement" began in 1902, with the writing of <u>Garden Cities of Tomorrow</u>. Howard defined the Garden City as a "town designed for healthy living and industry; of a size that makes possible a full measure of social life but not larger; surrounded by a rural belt; the whole of the land being in public ownership or held in trust for the community." (Quoted in Campbell, p. 19) Howard's work was the basis for two early British garden cities, Letchworth, begun in 1903, about 35 miles north of London, and Welwyn, begun in 1919, about 25 miles north of London. These towns consisted principally of row houses surrounded by large open spaces and some commercial and industrial land uses (Campbell, p. 19). Several towns embodying the Garden City idea were built in the United States, the first being Radburn, New Jersey in 1929, followed by three government sponsored greenbelt towns built during the depression--Greenhills, Ohio; Greendale, Wisconsin; and Greenbelt, Maryland. Park Forest, Illinois was built following World War II. All of these towns are largely residential in character as a result of their inability to attract sufficient industry to approach economic self-sufficiency.

The development of Reston, Virginia in 1962 marks the beginning of the contemporary new town movement. Reston, which is located about 20 miles west of Washington, D.C., now occupies over 7,000 acres and has a population of about 30,000 people. Other new towns in the Washington, D.C. area are Columbia, Maryland; St. Charles, Maryland; and Fort Lincoln, which is in Washington, D.C. itself. The number of new towns in the United States in which development has progressed substantially is at least 29. Eight of these are in southern California--Westlake, Valencia, Irvine, Mission Viejo, Laguna Niguel, Rancho California, Rancho Bernardo, and Rancho San Diego. These eight new towns alone represent a <u>planned</u> population of nearly one million people or somewhere between 5 and 10% of the population of southern California residing between Santa Barbara and the Mexican border (Campbell, p. 23).

New towns are classified by the New Communities Council in five categories:

Satellite--located on the edges of metropolitan areas and somewhat dependent upon an existing economic base;

Free standing--designed as largely self-sustaining towns and located in rural areas;

New Town In-Town--located within an existing city;

"Company" New Town--a residential community developed by a corporation as an adjunct to an industrial operation in an undeveloped area where conventional communities are absent;

Growth Center--use of an existing community as the nucleus for a new community. (Griffin, p. 4)

Almost all new towns now being built are in the satellite category. Campbell notes that "while most of these are attempting to balance their profile with commercial, industrial, and residential activities, it is unrealistic to think that any new town can exist entirely as an entity unto itself. If over the long run--that is, after development is complete--half the population can enjoy living and working in the same town, I would consider it successful." Campbell also comments that is is incorrect to think that rurally located new towns will be self-sufficient because he believes that they must serve the regions they are located within and that anything less will be strongly to their disadvantage. He views the reduced quality of life in most metropolitan areas as causing a reversal of present urbanization trends but believes that this reversal is not likely to occur in a rapid fashion without a firm national growth policy, presumably one that stimulates rural development.

It appears that free standing (rural) new towns hold the promise of reducing energy consumption if they are successful in creating a viable economic base and integrating small scale agricultural production with the life of the town. This is essentially the decentralization ideal held by Schumacher and others, although they do not advocate new towns as the only method of approaching the objective (Schumacher, 1973).

Rationale for new towns. According to Campbell (p. 25), for many residents the new town represents an escape from the rat race of the urban area, which consists of living in the suburbs, working in the central city, and spending endless hours commuting. For some, the new town represents a sense of adventure or pioneering activity toward a new way of life; for others, new town living can represent freedom from the automobile. The new town is also seen as an alternative to the rigidity of small town living without the anonymity and stress that is characteristic of the central city (Campbell, p. 25). An important point made by Campbell is that new towns offer a different lifestyle through the opportunity to affect decision making and participate in the process of community life and growth, a benefit that is sought by many individuals. Margaret Mead speaks more forcefully to this point.

> New Towns are necessary to a society that has lost its way--lost its way in building segregated suburbs, in driving freeways through the centers of old neighborhoods, in tearing down the heart of cities and leaving only a gaping vacuum of high rise office buildings where people once lived. New Towns are necessary as we take our first groping steps towards righting the havoc that has been wrought by letting our railroads fall to pieces; our trolley cars fall into disuse; our theatres, libraries, and shops that once invited people into the city give way to scattered suburban centers or to abandoned buildings with their unused windows barred with iron gates. New Towns are a kind of light that beckons us ahead, that shows that it can be done; they are a reassuring first step. (Campbell, p. 267)

The strong message that emerges is that existing urban areas have failed to provide not only for the material needs of many persons but, even more importantly, for their psychological needs. The possibilities of overcoming the wide sense of isolation and providing a community of interacting and caring persons, rather than just a physical entity, is among the most important hopes held for new towns. Many speak of "a sense of community" (very loosely) to indicate a special quality of interpersonal relationships which presumably stem from a commitment to the goals and activities of a group.* In its most advanced form found in utopian communities (intentional communes), especially of the 19th century in the United States, commitment mechanisms were so strong as to submerge individual identity almost entirely (Kanter, 1972). Compared to these communities, the large new towns of today have only the mildest sort of pressures for community identity and commitment, and one can live there without any more community spirit or commitment than is typical of suburban communities.

In their superb book, Communitas, Percival and Paul Goodman analyzed the relationship between the way people live and the physical setting in which they live. Existing cities and modes of activity were examined and a variety of utopian plans for reducing the dehumanization of cities put forth. Among the many things the Goodmans stressed is that cities have been designed for efficient production and not for providing services for meeting the needs of human beings who live in them, especially the psychological needs. Their analysis stems from questioning what form and function mean in terms of human well being and leads to sharp criticism of the kind of planning that is concerned only with industrial development. They believed that overplanning, excess centralization and control, and excessive scale are deadly to the satisfaction of human needs. The basic thrust of their recommendations is in the direction of decentralization and integration, with a preference for work places to be more effectively integrated with living places so that children will grow up with first hand knowledge of the work that adults do. To the extent that new towns are of more human scale, allow more active face-to-face participation of their residents, and integrate work, play, and other activities of life more effectively, they can approach the Goodmans' view of a desirable city. However, it is questionable whether any large satellite new towns come close to approaching this ideal.

3.2 American New Towns of the 60's and 70's

Campbell (1976) describes seven American new towns, including an excellent in-depth study of Reston, which he has observed as a resident for some years. Although he is strongly positive about the new towns he has seen, he is careful to point out the potential defects as well as the benefits. His case studies, Griffin's study of Irvine and my visit to Irvine form the basis for the following comments.

Most new towns have a similar hierarchical structure, which generally consists of three levels. The cluster, or neighborhood, level contains the smallest grouping of houses (perhaps 30-50), the village level generally consists of several clusters and has a total population of several thousand persons, (although at Irvine the village population may be 25,000), and the entire town or city, which comprises the villages and, perhaps, a town center. Most of the new towns are planned for eventual populations of at least 50,000 persons and several are planned for well over 100,000 persons (Irvine at 400,000 is the largest).

The key to the social structure and internal governance of the new towns is the homeowners associations (HA) (also called community associations (CA)), which may exist at several levels. In Reston, for example, there are HA's at the neighborhood, village, and town level whereas at Irvine there is only a neighborhood level HA. There are no plans at Irvine for adding another level of HA since it is felt that direct interaction between the HA's and the Irvine City Council,* is more effective than another (time-consuming) layer of citizen organization (Cameron, 1976). Since all five members of the Irvine City Council previously were active in HA's themselves, it was noted that they are responsive to citizens' needs and supportive of citizen participation in decisionmaking. It was emphasized that the Council is highly independent and often at odds with Irvine Company wishes--especially with regard to the provision of a specified amount of moderate cost housing ** (Cameron, 1976).

The extensive participation in the decision making and social life of the community is a hallmark of the new towns and creates an essential difference in lifestyle between them and more traditional suburban communities. In a sense, the new towns are social experiments and some of their developers have consciously sought the benefits of greater participation among citizens in decision making and the establishment of viable communities.

In terms of physical environment--both natural and man-made--new towns are typically evaluated highly. Reston has three lakes, miles of walkways and bicycle paths, and very high architectural quality (Campbell). The automobile is typically separated from pedestrians and bicycles. Another important feature of the new towns is the extensive recreational facilities that

* Most of the development on the giant Irvine Ranch property is in the jurisdiction of the City of Irvine. However, parts of the ranch property lie within 5 other cities as well as unincorporated parts of Orange County. When one considers the presence of other regulatory and planning bodies, e.g., the Coastal Zone Conservation Commission, regional air and water quality control boards, local agency formation commission (LAFCO), the institutional complexity of the planning process may become evident.

** The Irvine Company is not happy about being forced (under the threat of further subdivision and rezoning approvals) to build at least 10% of their units in the "moderate cost" category.

are provided--swimming pools, golf courses, tennis courts, lakes and others abound. At Irvine, neighborhood parks and community swimming pools are numerous. For example, in the first phase of the Village of Woodbridge, which will contain 1763 housing units, there are 15 parks and 5 swimming pools in addition to a lake with a large swimming lagoon, boating, and other recreational facilities. Moreover, the parks in this Village will each have special features "...equipped to complement the special interests of the residents living nearby."* (Irvine Company Sales Brochure).

The availability of nearby recreation is extremely important in reducing energy consumption since recreational driving is one of the major uses of the automobile. Several of the residents of Reston interviewed by Campbell commented that most of their recreational activites took place only a few minutes from their homes, thus eliminating the need for the extensive driving required in most urban areas. The provision of commercial facilities is almost as important in reducing trips by residents, and it appears that most of the new towns have extensive commercial facilities, some including very large regional type shopping centers, although most shopping centers are of the smaller neighborhood variety or located in a town center.

One of the major design features at Irvine is the activity corridor which contains community level facilities--schools, community parks, village shopping centers (including office space)--in close proximity to, and aesthetically compatible with residential areas. In the earlier villages the shopping centers were placed on the periphery of the village but now

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* The Irvine Company has identified 9 categories of buyers, for which it provides different housing and recreational facilities. The Company is extraordinarily successful at selling what it builds.

they are within the village, for better access. Nevertheless, the scale of the typical Irvine village is so large that most people will drive, as there is no local public transit available.

Several, although not all, of the new towns studied by Campbell have been quite successful in providing economic and racial integration of their communities. Neighborhoods are typically designed to include apartments, townhouses, and detached single family residences which vary across a broad price range, thus not separating persons on the basis of income. In addition, subsidization of housing sometimes exists, without identification of those who are subsidized.

At Irvine the integration of moderate income people into the community has become a major political issue, largely as a result of the perceived lack of effort by the Irvine Company to insure such integration. The Irvine City Council has taken the initiative to force the Irvine Company, by withholding future subdivision or rezoning approvals, to provide at least 10% of their housing units in what may be called a moderate cost category, which in mid-1976 was between $31,500 and $33,000 for row housing of much lower quality than the typical Irvine Ranch product. These units are small (approximately 1,100 square feet) and spartan looking with virtually no private outdoor space, although they share the same neighborhood amenities as more expensive units nearby.*

The percentage of black residents is described as high for such new towns as Reston, Columbia, and Park Forest South, where percentages vary from 10% to somewhere above 20% (Campbell). Most black residents are

* Despite its lower level of amenity, Irvine Company planners contend that the price will increase dramatically when these units are resold by the original buyers. The Irvine Company feels that the main result is to provide some people with windfalls rather than providing moderate income persons with good quality housing. This is certainly a legitimate and important issue in the area of subsidized or regulated housing.

described as being middle class, fully participating members of their communities, who generally express a high degree of satisfaction with the new town environment.

<u>Commerce and Industry</u>. The extent to which commercial and industrial activities are attracted to new towns differs considerably, partly because of the different stages in the life cycle of the various towns. The amount of industry and commerce is, of course, a crucial factor in the success of the new towns and bears highly on energy consumption, especially in work trips. As of late 1973, Reston had over 127 business firms representing almost 5,500 jobs. Included are 2,500 jobs provided by the headquarters of the U.S. Geological Survey. Columbia has been even more successful, having attracted the General Electric company to locate a $250 million appliance assembly and warehouse facility in the town. The General Electric facility will ultimately provide 10,000 jobs which will amount to nearly 20% of the Columbia employment total. Columbia is expected to have about 800 firms which will eventually provide 60,000 jobs; however, the present number if not reported.

Irvine, with a projected population of 400,000 by the year 2000, has a present (late 1976) population of more than 40,000. It features an industrial park* (Irvine Industrial Complex) which is reputed to be the fastest growing in the nation. This complex, occupying a 4,000 acre site, already has more than 1,000 tenants who employed over 55,000 persons in November 1976. Most of these workers commute from other parts of the Orange County and Los Angeles metropolitan areas. It would be extremely interesting

* About one-half of the land area and employment in the Irvine Industrial Park is outside the City of Irvine.

to learn what the commuting patterns are for the people who work in the Irvine complex and in other parts of the town. Only very partial data are available now. These show that about 8% of the persons employed in that part of the IIC which lies within the City of Irvine are residents of Irvine. A survey of commuting distance of workers in the City of Irvine showed an average trip distance of 17.5 miles and classified 41.7% of the trips as short (less than 15 minutes), 34.3% as medium (15-30 minutes) and 7.9% as long (above 30 minutes). Another 9.5% of those surveyed were Irvine residents and were not included in the previous figures and 6.6% failed to respond (ENVISTA, 1976). The project manager for the study said that he expected considerably longer commuting distances and times (Nelson, 1977).

Lifestyle Implications

It is difficult to determine the extent of differences in lifestyle between the new towns and more traditional suburban communities. Much more extensive and thorough social science research would be required than the impressionistic research conducted by Campbell in his studies. It is clear that there are several areas of probable difference, including ones which relate to energy consumption. Already noted is the higher level of participation in community affairs and interaction among individuals. It appears that, at least to some extent, the isolation found in typical suburban communities has been reduced and that some "sense of community" is being achieved for many of the residents.

To some persons this has negative lifestyle implications. One Reston resident interviewed by Campbell felt that there were excessive layers of government within the town and that the cluster association imposed tremendously on their lives. This woman noted, however, that her family did enjoy the commuter bus, the swimming pools and the footpaths. Nevertheless, she felt that her family was "disintegrating in Reston" (Campbell, p. 41). Clearly the high level of community involvement that is expected may lead to social pressures that are viewed as an imposition by some persons. Involvement in community affairs will infringe on the time people typically spend in other activities and some will not be willing to give up those other activities for the increased level of participation. It is likely that the attitudes about appropriate behavior in the new town will create significant social pressures for participation and make those who are not willing to participate uncomfortable and feel that they are outsiders.

One man noted that new towns have not dealt with the needs of housewives. He thinks that new towns are planned from a male chauvinist point of view and is quoted as saying "It is great for the man who drives to the city every day and is involved in the hustle of urban life...Then comes home on the weekend to get away from it all" (Campbell, p. 40). Teenagers, too, do not see the new town as Utopia, and several commented that there is not enough to do and that the town is boring and artificial.

It is apparent from Campbell's interviews and analysis that there is a higher degree of activity within the community which would reduce the use of the automobile. Extensive recreational facilities are nearby, footpaths/bicycle paths within the community are used extensively, and major shopping facilities are also within easy reach. Reston has also been successful in developing a commuter bus system, which runs to downtown Washington D.C. The forty-five minute trip is made by about 2,000 Reston residents per day out of a total work population of perhaps 10,000-15,000. When one considers, in addition, that a substantial number of Reston residents hold jobs within the town, it is likely that energy consumed in work trips is significantly lower than it would be in a comparable suburban community. In the southern California new towns, however, the prospects for establishing successful bus systems are much lower because there is not a single major destination as there is in the Washington D.C. area. In Irvine, a large percentage of the 55,000 persons who work in the Irvine Industrial Complex commute from other areas by car, as bus transportation is highly inadequate. It is likely that, in time, many persons who work at the Irvine Industrial Complex will move closer to their jobs, although not necessarily to the Irvine Ranch.* The development of the employment base at Irvine preceded much of the housing there so that most early employees were forced to commute. There may be a "catching up" process in operation, where more of the workers move closer to their new employment location. Unfortunately, very high housing prices at Irvine (the median price is approaching $80,000) will prevent most middle income employees from buying homes there.

The potential for reducing gasoline consumption at Irvine by various public transit alternatives seems to be considerable but is not likely to be realized in the foreseeable future. Public transportation planning for Irvine is the responsibility of the Orange County Transit District and no new private systems are allowed to operate in the District's territory. The present level of public transportation serving Irvine is low and there is no local service within the town (Jones, 1976).

Summary

The lifestyle in the typical satellite or suburban new town can hardly be characterized as frugal. On the contrary, what exists and is being promoted is an affluent mainstream lifestyle in a "nicer place to live."

* According to Nelson (1977) there is evidence of such a trend, not only at Irvine but in other parts of Orange County.

However, energy use for personal transportation can be reduced by the shorter work and recreation trips (or trip frequency), which is encouraged by new towns.

3.3 New Towns Planned for Energy and Resource Efficiency

The new towns discussed so far, which represent by far the great majority of those under development, were not designed with energy and resource consumption in mind. Some were well designed to be compatible with their physical environment and certainly to provide an appealing physical setting for their residents. However, this is far short of designing a town with the specific goals of reducing the consumption of energy and other resources.

Cerro Gordo: An Energy Efficient New Town

A quite different type of new town in scale, concept and method of planning is Cerro Gordo, Oregon. Cerro Gordo started with a "search for community" before a physical plan was developed. Several years have been spent in the "coming together" of its participants, during which time they have been working out interpersonal relationships and methods of decisionmaking as well as developing a community plan. "In essence they are erecting a community of people, not buildings" (Cassidy, 1974).* The development of Cerro Gordo resembles that of a utopian community more than it does the new towns described in the previous section, which were planned by the developers as large real estate ventures. Cerro Gordo follows Margaret Mead's injunction for persons to get together and select each other before the town is built.

* A detailed record of the genesis of this new community may be found in various publications of The Town Forum, especially those of August 1974 and Fall 1975.

> The next step must be the early involvement of the future residents, and not only in the planning and in the hearings on policy; the future residents must be allowed to choose each other before the new town or the new town in town, or the satellite town is built. There is no need to treat new towns as if they were voyages from one port to another with passengers who have never met. Old kin and neighborhood and friendship ties could be maintained, and the human fabric of the new or rehabilitated communities could already be partly woven before foundation stone is laid or a single unit goes up.
>
> (Mead in Campbell, p. 269)

Such a course is harder to follow but the people of Cerro Gordo have done so over a period of more than five years.

Planning a new community in this manner is complicated greatly by the problem of size--it seems to require a small core group of participants. In the Cerro Gordo situation the project was initiated by a few people and publicized widely to obtain the participation of others. The core group of committed persons was expanded to about 100. Individuals who were interested in Cerro Gordo decided whether they would make a serious commitment after meeting persons in the core group and sensing their reaction. When such a course is followed, problems of the admission of new members to the community become much greater than they are when the new town is planned by a developer, who is first selling buildings and secondarily, a lifestyle concept. The original group in a new town such as Cerro Gordo is likely to be much more cohesive than groups of residents in the more typical new town. The problem of maintaining its identity, cohesiveness, and commitment to certain ideals, while admitting new members, is one of the major problems that utopian communities have faced through their history, a subject that has received excellent treatment by Kanter (1972).

Despite their prior attention to the interpersonal aspects of community, Cerro Gordo members have been involved in physical planning of the community since 1972. A detailed land use map and plan for the village and the entire community has been drawn up using concepts of environmental design, such as land capability analysis developed by Ian McHarg.* The plan embodies principles of resource, energy, and land conservation and strives for a minimal impact on the environment. Most of the 1200 acre site will be retained in its natural state or in agricultural use, which should be possible if most of the projected population of 2000 is willing to live at slightly higher densities than is typical for suburban subdivisions.

Present Status of Cerro Gordo

As of November, 1976 approximately 100 individuals and families--the future residents of Cerro Gordo--were members of the community association. These are the persons who are actively involved in the planning and decision-making for the construction of the community. About 75 live in the Cottage Grove area, near the Cerro Gordo ranch, and are engaging in a wide variety of community activities. The 10 families who will be the first home builders and residents of the townsite recently formed the Cerro Gordo Cooperative, Inc. as the permanent residents' association. The Cooperative purchased the entire ranch from the original partnership of 75 families and is in the process of registering a stock offering so that it can raise capital for the future development of the town.

Construction of the first buildings on the townsite was expected to begin early in 1977. Land use and building permits as well as approval for water and sewerage systems have been obtained. A well was drilled and tested, construction access developed, lake drainage installed, and two residential clusters staked out for construction. One cluster will have 4 semiattached homes with common laundry and shop. The second will consist of 4 attached townhouses with a cluster kitchen and a lounge in an adjacent community

* See The Town Forum, August 1974 and Fall 1975

meeting hall. Both clusters will incorp[illegible]design features such as solar panels and dual sewer lines, one for gra[illegible]. It is interesting to note that the November 1976 report indicates that several changes in the design features of the first cluster were made from the previous plans of 1975 (Town Forum, 1976). Housing in the earlier plan was described as containing "...a multi-nuclear family unit (which has the flexibility to handle from one rich person to two couples and their kids), a boarding house that consists of six bedrooms/studio suites sharing a common kitchen and three bathrooms and two more or less standard family units." (Stevens, 1976; p. 32) The design features were to include: 20" basalt rock walls to separate the units; two and one-half story buildings for heat conservation, minimal impact on the terrain, and a good view of the lake and mountains; a Clivus Multrum composting toilet in one unit (in addition to conventional systems in all units) to help secure state and county approvals for the Clivus toilet; heavy insulation (9[illegible] ceiling), double glazing and water saver toilets; a greenhouse on the third floor deck; flexible eating spaces, with a choice of installing a private galley kitchen, using the boarding house kitchen, or the large kitchen in the nearby community hall (Stevens).

The attempts at solar heating the apartments are of interest as they reflect some conflict with lifestyle choices made by the residents in their housing design. Initially, it was planned to provide solar heating for the housing units, but a hitch developed when it was found that the residents wanted sleeping lofts in their apartments. The difficulty of adding sleeping lofts and integrating the solar collector design were considerable. One of the design alternatives suggested by the architect was the use of a slanted roof. However, calculations for reflector efficiency indicated that the alternative would be too expensive and it was decided, instead, to place the solar collector on the community hall (Mowat, 1976; p. 34).

It is not clear to what extent the original ideas will be incorporated in the first cluster but it does appear that the diversity found in the original plan--a multi-nuclear family unit, a boarding house, and two standard family units--has given way to a more conventional semi-attached unit design. Nevertheless, the housing still contains desirable energy and resource conserving features.

Economy of Cerro Gordo. The economic development plan for Cerro Gordo aims at attracting a variety of compatible light manufacturing and commercial ventures which will provide employment for a large proportion of Cerro Gordo residents. This is the ideal of a self-sufficient new town. Plans are being drawn for an industrial cluster--a modular building, which will initially contain between 4000 and 6000 square feet. Additional modules can be added as needed and leased to businesses which locate in Cerro Gordo. There are several committed tenants at present--a manufacturer of scale models, The Town Forum (research and publishing), a community market which will engage in mail order retailing, an artwork and advertising firm, and community offices. Cerro Gordo has sent a large number of brochures to small businesses throughout the country with the objective of convincing them to locate in the new town.

Plans for purchasing nearby farmland to produce sufficient food for the community and to integrate farming and homesteading lifestyles into the community are being pursued. The community association is also advertising for prospective homesteaders and farmers to locate there, as there are apparently not enough farmers among the original community association membership. A forestry program has been initiated with selective thinning and reforestation underway to supply an adequate wood supply for community heating needs.

Existing and impending land use permits will allow the construction of up to 40 homes in Cerro Gordo. The community has adopted guidelines for a wide variety of cluster types and are seeking a homesteading cluster, a log cabin cluster, a cluster with a large communal geodesic dome, and a cluster for retirees near the future town center. The community association is inviting potential participants and will allow them to propose any cluster that is in accordance with the community plan. The latest progress report notes that in addition to homesite planning, the community association members will be discussing and adopting village center plans, architectural guidelines, and utility and paving plans for the first 60 to 120 homes and plans for the first phase of a trolley line, which they hope to begin building within the next year or two. It should be noted that their intention is not to use automobiles in the town at all.

It is evident that building a new community of this sort is extremely difficult, as the reports from Cerro Gordo attest. Cerro Gordo has been unusually active in publicizing its venture and has done an excellent job. In addition to the distribution of <u>The Town Forum</u> they have held meetings in several major cities in California. Although there are more than 4,000 subscribers to the <u>Town Forum</u>, the number of persons initially interested in at least taking an active role in the planning of the community has been about 100, many of whom now live in the Cottage Grove area. 75 were original investors in the ranch property. However, of those 75-100 CA members, only 10 families or businesses are included among the initial investors in the Cerro Gordo Cooperative. And, it appears that only 5 CA members have committed to reside in Cerro Gordo initially, as the community association is advertising for outsiders to purchase 3 of the 8 original housing units. The CA is also finding it necessary to advertise for future residents to absorb the approximately 40 building permits that have been issued or are now pending. Thus, the question arises as to why most of the 75 to 100 members of the community association are not yet ready to locate in the new town.

Ventures such as Cerro Gordo face formidable obstacles in obtaining commitment from potential members. As already noted, they resemble utopian communities more than they do traditional developer-planned new towns. The literature on utopian communities indicates that a strong shared ideology is essential for success and that religious communities have been the most successful. It is not yet evident whether communities such as Cerro Gordo can develop a sufficiently strong secular ideology based on the desire for an ecologically sound and conservation oriented (frugal) lifestyle, coupled with strong interpersonal relationships, to be successful. From experiments such as Cerro Gordo we should be able to learn a good deal about the construction of new communities which are based on the desires for such a lifestyle.

Chapter 4. Housing and Subdivision Design in Existing Communities

Since most of the U.S. population will, for many years to come, continue to live in presently existing communities rather than in new towns, the innovative design of housing and entire subdivisions holds the promise for important energy conservation benefits. Fortunately, the opportunity for a case study is available in the City of Davis, which recently passed an ordinance establishing energy conservation performance standards for residential construction (Ordinance No. 784). Also, within the City of Davis is an innovative subdivision which goes well beyond the requirements of the ordinance and may serve as a model for subdivision design for energy and resource conservation.

4.1 The Davis Energy Conservation Ordinance

The City of Davis, located 15 miles west of Sacramento, has grown rapidly from about 8000 persons in 1960 to over 30,000 today. This growth has closely paralleled that of the University of California campus, which now numbers more than 17,000 students. The influence of the university community was felt strongly in the adoption of what is commonly known as the Energy Conservation Ordinance, (Ordinance No. 784, October, 1975). As a result of the long-standing research activities of two Davis faculty members and the more recent involvement of several former graduate students, who actively promoted such an ordinance, a contract was awarded for the development of an energy conservation ordinance. This study resulted in the publication of "A Strategy for Energy Conservation," (Hammond, et. al., 1974) in which a proposal for regulating building and subdivision design was presented to the city council early in 1975. After considerable debate and discussion, and in response to the objections of developers, the original proposal was modified and an Ordinance for Establishing Energy Conservation Performance Standards for Residential Construction within the City of Davis (Ordinance No. 784) was adopted. The key section is reproduced below, along with Table 2, which is referred to in the Ordinance.

<u>Section 3. Minimum Performance Standards Adopted</u>

The City of Davis hereby adopts minimum standards for the thermal performance of buildings to be constructed within the City of Davis. In order to achieve maximum thermal performance, the performance standards have been carefully adjusted to the special problems and opportunities of the Davis climate. These standards shall apply to all residential structures designated Group H and Group I in the Uniform Building Code.

A. <u>Winter Performance Standard</u>. For a winter performance standard the Total Days Heat Loss per square foot of floor area during the winter design day shall be as follows: For single-family detached structures designated U.B.C. Group I, see Table 2; for multiple dwellings, U.B.C. Group H, the Total Days Heat Loss shall not exceed one hundred twenty (120) BTU's per square foot of floor area. Commonwall Group I structures shall meet Group H standards. The resolution establishing methods of compliance with the performance standards will allow for numerically increasing the permissible standard on the basis of surface areas in common in order to equitably deal with the variability which occurs in this class of dwelling units.

B. <u>Summer Performance Standard</u>. For a summer performance standard, the Total Days Heat Gain per square foot of floor area during the Summer Design Day shall be as follows: For single-family, detached structures, U.B.C. Group I, see Table 2; for multiple dwellings U.B.C. Group H, the Total Days Heat Gain shall not exceed forty (40) BTU's per square foot of floor area. Commonwall Group I structures shall meet Group H standards. The resolution establishing methods of compliance with the performance standards will allow for numerically increasing the permissible standard on the basis of surface areas in common in order to equitably deal with the variability which occurs in this class of dwelling units.

Table 2 *

DETACHED GROUP I DWELLING UNIT THERMAL STANDARDS

Floor Area (sq. ft.)	Winter Heat Loss (BTUs/sq. ft./day)	Summer Heat Gain (BTUs/sq. ft./day)
500	363	118
1000	239	103
1500	208	98
2000	192	95
2500	182	93
3000	176	91

NOTE: Direct interpolation shall be used for floor areas not shown.

* Infiltration and internal heat production are not considered under the requirements of these standards. These are very important considerations in the real performance of a building and must be estimated when sizing heating and cooling devices whether conventional or solar. However, for the present purpose they are too variable to be standardized.

To meet performance standards would require a series of complex calculations by an engineer or other persons knowledgeable about the thermal behavior of buildings. To ease this burden on developers, a resolution was passed concurrent with Ordinance No. 784 which adopted procedures for compliance with the ordinance. The resolution established requirements for insulation of the structure (wall, ceiling, and floors, if not concrete slab), wall color, glass area (for double pane as well as single pane glazing), shading of glass areas, and ventilation for summer nighttime cooling. The resolution is reproduced in its entirety in Section 4.4. An analysis of the rationale for these requirements and the importance of building orientation and other means of improving natural (solar) heating in winter and allowing adequate cooling in summer without mechanical air conditioning is presented by Hammond et. al. (1974).

4.2 Subdivision Design for Energy Conservation

Four items of neighborhood planning (subdivision design) for energy conservation are discussed by Hammond, et. al. in their informative document: circulation and street design, land use (apart from that needed for circulation), street and house layout for efficient use of the sun, and landscaping for climate control.

Circulation. Methods are recommended for enhancing the appeal of the most energy efficient modes of travel (within the city)--walking and bicycling. Included are intra-block and cul-de-sac easements to shorten the paths of walkers, special bicycle paths which are separated from roads and streets, and better microclimate control to reduce the effects of heat and wind on pedestrians and cyclists. To achieve the latter objective narrower street widths are recommended since the narrower street has less heat absorbing asphalt and also permits more effective use of landscaping to shade the street and houses. It has been found that overly wide unshaded streets can result in maximum temperatures that are 10°F higher than on narrower, shaded streets (Hammond, et. al. 1974). The authors recommend that the least traveled residential streets should be no wider than 25 feet and ideally would be 20 feet, with parking bays for diagonal (front-in) parking. The present minimum street width is 25 feet and most new subdivisions exceed the minimum.

Efficient Land Use. For more efficient land use within the subdivision Hammond et. al. recommend a redesign of the typical residential subdivision to eliminate or reduce spaces that are under-used, e.g., front yards, side yards. Their analysis of one subdivision showed that, on average, 19% of the total space was taken up by the front yard and

11% by the side yard. By comparison, the houses themselves occupied only 15% of the total lot area (average value). A change in the setback requirements could allow a much more efficient placement of the structure and perhaps encourage the clustering of houses (in groups of 4). The present regulation in Davis also requires that a fence higher than 4 feet be set back 20 feet from the edge of the sidewalk. Eliminating this requirement would encourage front yard gardens, which most homeowners are reluctant to consider because of concern for neighborhood reaction, and the use of large glass areas on the street side of buildings whose south sides face the street. If the fence must be set back 20 feet it is likely to be too close to the building and will reduce the solar heating capability in the winter. The authors are realistic in recognizing that many persons will not sacrifice privacy for the benefits of solar heating.

Efficient Use of the Sun. The authors stress the importance of lot layout and shape for achieving proper north-south orientation of the building. Also of importance is the size and placement of nearby buildings so they do not block any of the available sunlight. It is now important to plan in three dimensions, not two.

Landscaping for Climate Improvement. The benefits of well-placed large trees for keeping a building cool in the summer needs little comment. Hammond, et. al., note that a 20°F temperature differential can easily exist between a shaded building and one that is not (and presumably not air-conditioned). Vegetation cover, not only trees, can have a dramatic effect on urban temperatures. This is a result of the urban heat island effect (Myrup, et. al., 1972) whereby the structures and streets absorb and store large amounts of solar radiation during the day. If there is little vegetation most of the incident solar radiation is absorbed by concrete. Also, the absence of vegetation reduces the amount of water vapor that is transpired by plants into the atmosphere, and results in a drier climate. However, heavy shading by trees has the undesirable effect of limiting the rate of cooling at night by screening the cold night sky. Another important effect in arid regions is the large water requirement of the trees.

4.3 An Energy Conserving Subdivision: Village Homes

Village Homes, an innovative subdivision now being built in Davis embodies energy and resource conserving features which go beyond the requirements of the Davis Ordinance. Of special interest is the plan of its designers, Michael and Judy Corbett, to build a small village which includes a farm, a village center featuring a food coop, craft shops and several other appropriate commercial establishments, and recreation facilities. In effect, the Corbetts are trying to plan a community which embodies features of new towns and strives for greater community suffi-ciency, leading to less dependence on the economy of the city and the region. However, the interpersonal aspects of community are at least as important to the Corbetts as the energy conservation aspects of the pro-ject. Mr. Corbett sees this as a social experiment not unlike that of other utopian communities (Corbett, 1976). To facilitate interaction and share decisionmaking, a homeowners association has been established. The homeowners association will have decision making power over develop-ment of the commercial and agricultural enterprises of the Village as well as over the use of common areas and the development of recreational facilities. The plan for Village Homes contains many of the characteristics and objectives of new towns, yet is solidly anchored to the realities of housing development in an existing city. However, it contains several features not normally found in new towns--an agricultural sector (still in the planning stage)--and a financial stake by the homeowners in the community enterprises. For these reasons it holds much promise and its implementation should be followed closely.

The agricultural enterprise envisioned for the Village is not the provision of a community garden but the operation of a small farm/orchard by a salaried manager and paid helpers. Residents of the subdivision will not be expected to work on the farm but those who do will be paid for their labor. It is expected that the produce will be sold through a Village coop store. Such a proposal clearly sets this plan apart from any that I have seen for a subdivision. Presently, it is expected that 18 acres will be devoted to agriculture (one-third the area of the subdivision), mostly in orchard, with some vegetables. Since most of the residents of Village Homes will not be working the farm to grow their own food, the produce of their farm will have to be reasonably competitive in quality and price with commercially grown items for the residents to buy a substantial share of the output--the desired goal. However, the homeowners will have an economic and psychological investment in the success of the farm since it will be owned and directed by the homeowners association. Thus, operating a farm as a "cottage industry," in which the residents of the Village have a significant investment may lead to the same result that would occur in a community of small individual homesteads--the products of the "community" being consumed by its members. The essential difference is that the Village Homes' agricultural enterprise participates more heavily in the market economy on the production side as well as the distribution side, i.e., labor is purchased rather than contributed by community members. Nevertheless, such a project could, on a very small scale, decentralize production and reduce the energy expended in the distribution of food, as well as reduce waste caused by spoilage and damage. It is also certain to reduce the energy inputs of fuel by the use of a larger proportion of labor (which may make the products more costly) and by the use of less chemical fertilizer and pesticides than are used in most commercial production. This enterprise merits careful evaluation as an example of the possibilities for decentralizing food production in suburban areas.

Although such an alternative is limited by the availability of suitable agricultural land, much of the urban development that takes place in California is on good quality agricultural soil. Integrating agriculture with residential subdivisions could result in less efficient land use than if the development were contiguous and could cause harm to nearby residents from dust, noise, and pesticides. When compared to the reality of land use at the urban fringe, however, a plan to integrate agricultural and residential uses may not result in less efficient use of land than already exists. Vacant land within urban areas is typically very high--between 30% to 50%--and is even higher in fringe areas, where most new development takes place. In Sacramento County, for example, 48% of the land within the defined urban area is classified as vacant (although it may be in agricultural use) (Johnston, et. al. 1977).

Moreover, if a portion of the normal residential lot (perhaps one-quarter) in each subdivision is dedicated to agricultural use, the result could yield residential densities that are nearly as high as those in typical subdivisions. Village Homes will have a density of about 3 units per acre, which is approximately 25% below that of new subdivisions in the city. The "loss" of a portion of each residential lot as private space can be ameliorated by more creative design of the subdivision. For example, if private rear yards are desired, they can be of approximately the same size as in present subdivisions by eliminating wasted space in front and side yards.

The mechanism for implementing such a plan can be a planned unit development (PUD), under which a portion of the land is approved for agricultural use rather than the more conventional greenbelt or park use. Village Homes was approved under planned development (PD) zoning, at which time permission was granted by the Planning Commission and City Council for the agricultural enterprise. As used in Davis, planned unit development zoning gives the Village Homes homeowners association the same legal right to carry on farm operations (minus animals) that a landowner should have on agriculturally zoned land (Owen, 1977). Depending on the way the PUD ordinance is written, other jurisdictions may not afford the same legal status to agricultural enterprises in a PUD.

<u>Village Homes Characteristics</u>

The first unit of the Village Homes subdivision is now substantially complete. This unit contains 36 single-family residences, including several commonwall units, 10 apartments, several lots on which mini-orchards have been planted, and greenbelt areas with bicycle paths. The subdivision incorporates many of the major features for neighborhood design that Hammond et. al recommended. Long cul-de-sacs which run east-west permit the houses to face north or south, and use large glass areas on the south side for winter heating. Nighttime ventilation in summer is enhanced by the north-south orientation since there are usually night sea breezes from the southwest, which typically cool Davis to an average minimum of 56° in July. The narrow streets (25 feet) are being planted with deciduous trees to provide ample shade in summer but permit maximum sunlight to enter the house in winter.

The houses vary considerably in size and design, partly because they are being built by several contractors in addition to Corbett. 20 houses and all 10 apartment units were built by Corbett, 9 were built by a "traditional" developer, and the remainder were built by individual contractors, including several for their own use. The houses are generally smaller in size than is typical for a subdivision of detached housing, but are comparable to semi-attached housing (2 units with common wall) with which they also compete. About one-third of the houses are between 1000 and 1300 square feet and were priced between $31,000 and $40,000 (including lot) at the time of their original sale. Another third are between 1300 and 1500 square feet and were mostly in the $40,000 to $50,000 price range whereas the largest houses are between 1500 and 2000 square feet and cost between $50,000 and $75,000. Lot sizes are typically between 3000 and 4000 square feet although some are as large as 6000 square feet. In Unit 2 of the subdivision both the average lot size and house size is expected to be somewhat higher. Prices in Unit 2 will be at least $5000 higher, with the lowest cost house at $36,000. Such an increase is consistent with that of the lower end of the housing stock in Davis during 1976 to early 1977.

Most of the Corbett-built houses are white stucco with red tile roofs in the Mediterranean style. Some have very narrow windows on the east and west sides to reduce undesirable summer heating in early morning and late afternoon. Roof overhangs on the south side prevent direct sunlight from entering the large glass areas in the summer, when the sun is high in the sky. All but 3 houses are built on concrete slab at grade, which provides desirable thermal mass (heat absorption and radiation properties) if the slab is not covered by carpet. Vinyl tile, ceramic tile, linoleum, and wood parquet do not impair the desirable heat conduction properties of concrete.

All of the Corbett-built houses exceed the Davis energy ordinance's insulation requirement, primarily by using 4 inches of blown insulation on top of the required R-19 fiberglass batt insulation in the ceilings. However, some go further--one house has R-19 in the walls, R-30 on the slant roof portion and R-38 on the flat roof portion. Many of the houses have some double glazing, and all have weatherstripping.

Nine of the houses (8 built by Corbett and 1 by an owner-contractor) may be considered as having solar space heating--all by passive means. Seven houses and all 10 apartments have solar water heating. The 9 houses with solar space heating vary from ones which incorporate some solar heating features--large south facing windows, improved insulation and some heat storage--to full solar houses, which have sufficient collector and storage capacity to provide heat during a cloudy period of several days.*

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* Because of occasional cloudy periods lasting more than 3 days in Davis, it is impractical (or impossible) to meet all of the heating requirements by solar energy. Thus, we will consider as "full solar" those houses with double glazed windows, moveable insulated window covers (generally panels rather than drapes), and substantial collector and storage capacity--enough to provide about 90% of heating needs.

There are 3 houses in the latter category--one recently finished and still unsold, one recently occupied, and one still unfinished. Two of these houses use steel columns containing several thousand gallons of water to provide the necessary energy storage. The 6 partial solar houses also contain large glass areas (double glazed) on the south side of the building. Two have clerestory or rooftop windows to permit sunlight to enter the middle or north sides of the building but do not have insulated shutters (as yet) to close these glass areas (at night in the winter and during the day in summer). Three houses use water barrels and a fourth uses waterbeds to provide heat storage capacity but the amount of water storage is relatively small compared to that in the full solar houses. All the solar houses obtain additional thermal mass from the concrete slab covered by ceramic or vinyl tile, wood parquet, or linoleum.

Wood burning stoves (Franklin type) have been installed in 11 houses with the intention (in most cases) of using them as the primary backup source during periods when solar energy is insufficient. Because of building code requirements, however, all houses have conventional gas furnaces and hot water heaters in addition to the solar systems. Although most of the owners initially felt that such backup systems were unnecessary (when they were interviewed before the winter) all of them found it necessary to use their gas furnaces during a prolonged period of cloudy weather in January 1977.

Characteristics of the Residents

The residents of Village Homes' single family houses are predominantly young, well-educated and affluent (Table 4.1). There are 58 adults--29 men, 29 women--with an average age of 31.0 years for males and 28.5 years

Table 4-1. Demographic Characteristics of Village Homes Residents

Residents of Single Family Houses:

1. Number of adults: 58 (29 males, 29 females)
2. Number of children: 7
3. Average age: Males: 31.0
   Females: 28.5
4. Homeowner marital status:[a]
   Married: 35.0%
   Single, widowed, divorced: 65.0% (28% female, 37% male)
5. Education: College graduate: 57%
   Graduate degree[b]: 17%
   Currently in College: 25%
6. Average household income: $18,000

Apartment residents

1. Number of adults: 17 (7 male, 10 female)
2. Number of children: 2
3. Average age: Males: 27
   Females: 24
4. Average household income: $10,000

[a] Percentages computed according to number of households

[b] 17% with graduate degrees included in 57% who are college graduates

for females. There are seven children. 65% of the adult residents are college graduates with 17% holding graduate degrees. 15% are employed in academic positions, including faculty, and 25% are students at UCD. The average annual household income is $18,000. The apartment dwellers consist of 10 women, 7 men, and 2 children, with an average age (of adults) approximately 4 years less than for residents of the single family housing. Average income per household is $10,000. 57% of the residents say they use a bicycle regularly for transportation, 11% carpool regularly and another 11% use public transportation regularly.

Appliance Ownership

An examination of Table 4.2 shows the difference between appliances installed in new Corbett houses and those installed by the traditional developer. A strikingly low percentage of Corbett houses contain what are usually considered to be essential appliances in new middle to upper income housing. Approximately 1/2 to 2/3 of these homeowners are willing to do without garbage disposers, dishwashers, clothes dryers, and air conditioners. It is especially notable that 2/3 of these households chose not to install air conditioners. On the other hand, more than half installed a woodburning stove. These results undoubtedly reflect two interacting factors. One is that Mr. Corbett has actively tried to influence the appliance choices of persons buying houses from him. Especially with regard to air conditioning, he feels strongly that the houses are built with sufficient insulation and north-south ventilation so that they do not really need air conditioning (Corbett, 1976). There is no doubt that he has been influential in reducing the purchase of air conditioning units. The second important factor, which is indicated by

Table 4-2. Appliance Ownership

Appliances	Corbett Houses	Traditional Houses
	% of houses in which appliances are installed	
Frostfree refrigerators	75%	100%
Self-cleaning ovens	8	80
Garbage disposers	40	100
Dishwashers	58	100
Clothes dryers	50	100
Air conditioners	33	100
Franklin-type stoves	58	0

interviews with the home owners and is reflected by their appliance consumption, is that many of them are strongly committed to energy conservation. Clearly, there is a self selection process at work in which a certain type of buyer has been attracted to Corbett houses. It is unlikely that as many households in a typical cross-section of the population would be willing to forego dishwashers, clothes dryers, and garbage disposers.

Energy Use

We obtained an initial estimate of household energy use by a phone survey in which homeowners were asked for the amount of their utility bills for the months of December 1976 and January 1977 and also the extent of wood use in fireplaces or stoves. These results must be considered as preliminary and indicative since the sample is small (19 houses) and only a 2-month period was examined.

The average monthly bill for 14 Corbett houses was $22.57 whereas for the 5 traditional houses the average bill was $40.20. Size of the houses accounts for some of the difference since Corbett houses average 1290 square feet whereas the other houses average 1620 square feet. Nevertheless, even when the utility cost is calculated per square foot of floor area the difference between the traditional and Corbett-built houses is statistically significant.*

A detailed analysis of the utility bills to attempt to break down costs into those due to electrical appliances, cooking and water heating, and space heating, has not yet been made. However, rough estimates will be attempted. Because of the much lower ownership of electrical appliances in Corbett houses, electricity costs will be considerably lower than

* Significant at p = .05 using the Welch-Aspin approximation to the t-test to account for unequal variances of the two subgroups (See Marascuilo, pp. 312-314).

average also. One house, which is a showcase for energy conservation, had an average monthly electricity bill over a four month period of $5.76 (the lowest monthly total was $4.71). If we assume that a more typical electricity use figure for energy conscious households is between $8 and $10 per month, a figure which is still substantially below the average for similar type structures in Davis* (Kopper, 1974), then the average monthly gas bill in winter for the Corbett houses is approximately in the $12 to $14 per month range. We estimate that the gas cost for both cooking and water heating is between $4 and $6 per month.** Thus, the remaining cost of between $6 and $10 per month can be attributed to space heating. It should be noted that in solar heated houses, the average monthly utility bill is about $4 less than for all Corbett houses. In these houses, therefore, the average gas cost for space heating is likely to be close to, or even below, the $6 per month figure. Therefore, for the lowest energy users, it appears that electricity consumption is less than 50% of the average for Davis homes and that gas consumption for space heating is roughly 80% less than the Davis average. Data for the non-solar Corbett-built houses indicates a space heating cost of approximately $10 to $14 per month. Thus, it appears that even the higher energy use Corbett houses are achieving at least a 50% reduction in the consumption of gas for space heating compared to the average Davis house.

It must be stressed that these are very preliminary and tentative estimates, based on a small data sample and for only a 2-month time period.

* The average monthly electricity cost December and January, based on 1973 consumption figures and December 1976 rates is $24.85.

** Estimate based on limited utility bill analysis and Newman and Day data for these uses, which shows water heating using 3.2 times the amount of natural gas as cooking (pp. 53, 61).

A larger sample will be analyzed over a period of at least one year with breakdowns of utility bills into electricity and gas components.

It is too early to determine all the specific factors that contribute to reduced energy use. Several appear to be important. One is the size of the house, which is generally smaller for Corbett houses than those of the traditional contractor. However, as noted, even when adjusted for the floor area of the house, Corbett households use considerably less energy than the others. A second factor is the activity pattern of the residents, especially the amount of time spent in energy consuming home activities. In at least 15 of the 19 households for which the energy use data were obtained nobody is regularly at home during the day. Also, there is a very small percentage of families with children compared to the more typical suburban neighborhood--average household size is only 2.14 for the Corbett houses surveyed and 2.40 for the traditional houses. Households with children use considerably more energy than those without. A third factor of potential significance is the use of wood. It has already been noted that approximately 50% of the Corbett-built houses have woodburning stoves (not fireplaces). While the Franklin type stove is relatively low in heating efficiency--roughly half that of some of the better Scandinavian designs--it can considerably augment the amount of heat provided for a house. The choice of a smaller house, activity patterns, and the use of wood as an alternative fuel source, can be considered lifestyle or behavioral choices which reduce energy consumption. Other behavioral actions that are evident at Village Homes are the willingness to substitute hand labor for appliances, and accept lower house temperatures during the winter and higher temperatures in summer.

Most of the persons in Corbett-built houses were keeping daytime temperatures below 65° even before the edict issued by President Carter in January. Some were setting their thermostats as low as 60° in the daytime and 55° at night. Last summer, some Village Homes residents were willing to accept temperatures in the low and mid 80's, rather than the more widely desired 72-75°. The conservation benefits of such changes in comfort level are very substantial.* In comparing the energy cost and energy use of the Corbett-built houses with those of the more traditional developer, it is clear that we are not only comparing differences in housing technology but also differences in lifestyle of the inhabitants. The more traditional houses were marketed through a realtor who was not trying to promote the concept of an energy-conserving community and did not inform the potential buyers about the true nature of the community. Buyers of Corbett houses were generally strongly supportive of energy conservation goals before they bought their houses. Moreover, as the project became more successful, Mr. Corbett pushed solar energy features harder. The result is that Corbett house buyers hold stronger attitudes toward energy and resource conservation than the typical cross-section of individuals of comparable income and education levels. Comparing the costs and energy use of solar heated to non-solar Corbett-built houses would be a possible way of "controlling" for the behavioral differences, in order to determine the benefits due to solar technology. However, the sample size in these sub-categories is too small at present to permit such a calculation. Our longer term analysis of a substantially larger sample should permit such estimates.

* Newman and Day show a 51% reduction in heating energy for San Francisco for a 7° thermostat setback (maintained 24 hours) (p. 49).

Our initial impression is that the commitment of many of the Village Homes residents to energy conservation is extremely strong in the household sector but is less strong when transportation behavior is considered. Although bicycles are used for a large percentage of work trips, Village Homes residents own about as many cars per household and do at least as much driving as other households with similar demographic characteristics. Since average work trips are very short, the remaining automobile use, largely for recreation, may actually be greater than is average for the rest of the population. Although Village Homes residents do not appear to be much different than others with regard to amount of travel, the percentage of compact and subcompact cars owned is well above that for the general population.

Lifestyle Implications of Energy Conserving Subdivisions

Some of the features incorporated in, or planned for, Village Homes are likely to require changes in attitudes or lifestyles of the inhabitants. Initial indications are that the residents of Village Homes, perhaps because they are atypical of residents of new subdivisions, have generally adopted the necessary lifestyle changes with enthusiasm. However, the important question for estimating the probable wider acceptance of similar housing/subdivision innovations is "what lifestyle changes would be required of most people who would constitute the potential market for such housing, i.e. middle to upper income suburbanites?" We will raise several of the most important lifestyle issues by means of questions and comment briefly on the basis of the incomplete information available at this time.

House and Subdivision Aesthetics

Are houses with less glass area, especially with few or no windows on the east and west sides, aesthetically appealing? Will the visual continuity between indoors and outdoors that is typical of California suburban houses still exist? Will some rooms be too dark because of reduced glass area and because of the need to close shutters and/or drapes during the day in the summertime? Will the use of the back yard be diminished both because of its small size and its reduced visual accessibility? Are people willing to accept floors without carpets or rugs, to improve the thermal properties of the building or will they wish to give up some of the energy saving benefits for a partially carpeted home? Are the steel drums or steel columns which are used to store water inside a building aesthetically objectionable or can they be integrated in a pleasing fashion with the building? Does the small lot size and narrow streets and consequent close placement of houses create an unappealing effect for the overall subdivision?

Comments. Most of the houses are built on an east-west axis so that windows face primarily north and south. Most houses have little or no window area on the east and west sides. Where there are east or west facing windows, many are extremely narrow, amounting to little more than slits. Several of the houses use stained glass in these narrow windows, which enhances the visual appeal of the building and reduces the amount of energy that enters the house. One owner, a dedicated conservationist, felt that it was pretty restrictive to not have east or west facing windows, since often the best views are in those directions. Thus far, the amount of glass used on the north sides of buildings seems to be fairly high and the casual observer may not be struck by marked differences between the amount of glass used in Village Home houses in the more traditional subdivisions. Based on very limited number of observations, rooms do not seem especially dark during the daytime with shades, curtains or drapes open. We have not had the opportunity to observe the interiors of any houses during the summertime when they should be fully closed during the day for minimum heat gain through the windows. We would expect that a house that is fully shuttered or draped would be too dark for most persons and that there will be some opening of drapes/shutters for light.

The visual and physical continuity between inside and outside of the house, generally made possible by large glass areas facing the back yard, will almost certainly be diminished by the Village Homes design. Private back yards are virtually nonexistant. Solid fences higher than 4 feet are strongly discouraged at the rear of the house. The common greenbelt area which runs behind all houses does permit some visual continuity between inside and outside where windows or glass walls face the rear of the house. We have no idea yet whether the psychological value of back yard spaces will be reduced because they are not private. It is entirely possible that compensating benefits will be gained by interactions that take place in the common greenbelt areas, an objective of the overall design for the community that underlies the Village Homes concept. Clearly, part of that design requires a reduction in the use of private spaces by individuals and the private back yard--the focal point of the California style of outdoor living--may become a thing of the past in Village Homes. However, it should be noted that homeowners are encouraged to create private spaces by fencing the front of their houses. Many front yard fences have already been constructed, at a height of six feet, to enhance privacy from the street and to provide garden space. However, such spaces are quite small compared to typical suburban back yards. To a certain extent the Village Homes design may be encouraging a reversal between the front and back of the house, compared to what is typical in suburban subdivisions.

The use of carpeting is widespread despite its reduction of the thermal storage capacity of the concrete slab. Most houses have carpet covering 50% or more of the floor area. If water is used for energy storage it may be simple enough to overcome this loss of storage capacity in the concrete slab by the addition of water mass, since water is a much better storage medium. Thus, it is not essential that floors be entirely uncarpeted. Other options exist for softening the effect of tile or wood floors without reducing their energy storage value. One household is using water-filled pillows to act as an energy storage device. Also, in rooms that do not receive solar energy directly, the use of carpet may have little or no effect on the heat storage properties of the building.

The impression of the subdivision obtained from walking through the first unit is quite different than that of the typical suburban development. The scale is clearly smaller because of the narrow streets and small lots, which results in much closer house placement. However, there is considerable diversity of house design and in the placement of houses, which contrasts with the sameness that characterizes many suburban subdivisions. The presence of greenbelts and general absence of fenced yards adjacent to the greenbelts contributes to an openness that would not exist otherwise. If fencing of backyards adjacent to the greenbelt becomes widespread, however, the result would be quite undesirable--a narrow green "alley" rather than an open common area.

Personal impressions of the visual character of the subdivision, of course, vary and are influenced by many factors. Some individuals--not residents--react negatively to the closeness of the houses and the narrow streets, feeling the subdivision is cramped. Others see a certain charm in the smaller scale and the diversity of house designs. Some European villages with much narrower streets and much closer placement of houses are widely regarded as beautiful or charming, whereas the suburban subdivision in this country with closer than normal placement of houses may be seen as cramped or tacky. Density is not the only determinant of visual appeal. If one associates large lots and wide spacing of houses with wealth and status, then reasons for feeling that closely spaced houses are unappealing are quite evident. If one believes that "small is beautiful" --self-sufficiency in energy production or conservation of land is desirable-- different aesthetic standards may result. The close placement of houses is not then seen as an indication of low quality but as a reflection of the pursuit of a desirable goal. One observer noted that the high visibility of solar technology may have great symbolic importance in reminding people of the goals of energy self-sufficiency and conservation that the subdivision is pursuing and cause residents to feel positive about other aspects (e.g. aesthetic) of the subdivision, which might not be the case with some individuals if the means for attaining these goals were not so visible.

<u>Size of house and lot and physical characteristics of the subdivision.</u> Are adjustments required to the smaller living spaces and lots? Is the lot too small to provide adequate play space for children? If front yards are used for gardens, is this acceptable to neighbors? Do the small lots encourage communication among neighbors and contribute to the sense

of community? Is the level of privacy adequate, or are neighbors too close? Is it tempting to build a fence or use other means to provide private spaces? Is there a noise problem because of the proximity of buildings?

Comments. Although we ask what adjustments are required for small living spaces, we should hasten to note that for many, probably most, Village Homes residents no such adjustment is necessary. Most of the smaller homes are occupied by only one or two individuals and it is not likely that they would have occupied larger living spaces if they had chosen to live elsewhere. Our detailed analysis of the survey responses will indicate whether any individuals have moved to smaller quarters because of a commitment to energy conservation or to the type of community that Village Homes represents.

Space for gardens is limited but placement of gardens in front yards alleviates the problem somewhat. It is also possible to use common areas for gardens if the group of households with decisionmaking power over a section of the commons area agrees to do so. As already noted, there will not be large back yards for children to play in but there are several mini-parks and greenbelt areas which may be adequate for some play activities. It will probably be several years before there is an adequate number of young children to determine how the subdivision works for them in terms of play space and opportunities for interaction with other children.

Most of the Corbett houses have 6 foot fencing in front, which ensures adequate privacy from the street. Several homeowners have erected 6 foot fences to the rear despite the wishes of Mr. Corbett and the design review committee that such rear yard fencing not be built. This fencing is clearly a reflection of the need of some homeowners for greater privacy. It should be noted that houses whose large south windows face the street can be made more private by the front yard fencing, which is acceptable and encouraged. However, houses on the opposite side of the street, where the large south-facing glass walls open on the greenbelt, are likely to have much greater problems if those homeowners do not erect fencing on the greenbelt side, i.e., to the rear of their house. Greater attention to the design of interior spaces will be needed to ameliorate some of the problems of privacy in houses whose large windows face the greenbelt. The coming summer is expected to test whether adequate privacy and acceptable noise levels can be maintained, since it will be necessary to open the houses at night to provide adequate cooling for the following day.

Several important benefits of the physical design of the subdivision emerged from the interviews with homeowners. Many of the respondents said that the physical layout--the closeness of the houses--was the primary factor in encouraging closer interaction and a sense of community among neighbors. The use of front yard fencing to ensure some visual privacy from the street does not isolate homeowners from each other. Another extremely important benefit is the feeling of safety among residents. Many persons agreed that these secure feelings came from the close proximity of several people whom they know well and can count on in an emergency.

Disadvantages that were noted in the subdivision layout included somewhat hazardous street design, inadequate playspace for children, and limited parking. Some persons felt that the streets, because of the curving design, would not be a good place for children to play because drivers would not have adequate time to see them and stop their vehicles, if necessary. However, the use of cul-de-sacs should reduce vehicle speed and the amount of traffic. It was also felt that greenbelts, at least as they appear in unit 1, would not be desirable play areas for children above 5 or 6 years of age, because of lack of adequate room for games such as football, soccer, and others that require considerable space, and that games on the greenbelts would likely wind up with children tromping into back yards and damaging the gardens. Although the first unit is primarily an adult community, present indications are that a larger number of families with children will be occupying homes in unit 2.

Parking also is a problem, at present. Because the streets are narrow, parallel parking is not allowed, there being several parking bays instead. However these bays do not provide adequate parking space. A party of any size will generally result in cars being parked illegally along the narrow streets, as there is no other place within the subdivision for them.

Heating and Cooling

The basic question is "to what extent are people willing to sacrifice comfort and convenience to conserve energy by reducing their use of heating and cooling devices?" Will they perform the tasks required to open or shut their houses for optimum cooling and heating (e.g., closing shutters, drapes, windows)? Will they use a woodburning stove or fireplace to provide heat in winter?

Thus far, the level of commitment and enthusiasm among Village Homes residents appears to be quite high. They are willing to perform the necessary tasks to reduce energy used in heating and cooling of their houses such as closing/opening shutters, drapes, and windows when required. Sealed shutters, which are made of plywood sheets with insulation between, are quite heavy and the task of putting them in place or removing them can be burdensome. If these are operated by counterweights it may take considerable effort to push the weight in one direction. Whether these discourage use remains to be seen but, at present, most of the residents see such tasks as part of a game rather than a burden. Thus far, it also appears that a substantial number of homeowners are willing to use woodburning stoves in their homes to augment the solar heating that they receive. Wood use among those who own Franklin stoves or other similar woodburning stoves was generally about 1/3 to 1/2 cord for the winter. This is a much smaller amount than is used by people who rely on wood stoves as their primary source of heat and is comparable to that used by many homeowners in their fireplaces.

Appliances

Are people willing to wash dishes by hand, dry clothes on drying racks or hang them on lines, and recycle vegetable wastes rather than using a garbage disposer? Will people be inclined to eat out (and expend their energy in travel) if they have no dishwasher? Will they entertain less as a result?

The appliance choices already discussed apparently indicate some people are willing to forego the labor saving benefits of dishwashers, clothes dryers and garbage disposers. The recycling of vegetable wastes rather than grinding them is facilitated by once a week pickup and the use of highly visible composting barrels on the property. The home pickup and the visibility of the bins not only facilitates, but also motivates, some homeowners to save their vegetable wastes. Individuals who would not otherwise consider composting their wastes are happy to do so because it is made easy and is a high status behavior in the community. Some have indicated, however, that, "if it were a hassle to do so they wouldn't do it."

We do not know to what extent Village Homes residents who have chosen to forego dishwashers or clothesdryers are happy with their choices. It seems safe to assume, however, that most people who can afford to have these appliances would choose them, especially in households where all the adults work full time and value the time savings of such appliances. The prospects for and implications of increased amounts of home labor, which is crucially important to the adoption of more frugal lifestyles, is discussed in chapter 5.

4.4 Appendix: Text of the Davis Energy Conservation Ordinance

ORDINANCE NO. 784

AN ORDINANCE ESTABLISHING ENERGY CONSERVATION PERFORMANCE STANDARDS FOR RESIDENTIAL CONSTRUCTION WITHIN THE CITY OF DAVIS

THE CITY COUNCIL OF THE CITY OF DAVIS DOES HEREBY ORDAIN AS OLLOWS:

Section 1. Findings.

A. The people of the State of California face the likelihood f a major energy shortfall and the certainty of rapidly rising energy osts due to uncertainties about present and future supplies of natural as, and the inability of powerplant construction to keep pace with the ising demand for electricity. Energy demand for the heating and cooling f residential structures has been rising faster than demand in other ectors and rising household energy bills are becoming an increasing conomic burden for lower and middle income families.

B. The State of California has adopted an energy and noise nsulation standard under the provisions of the California Administrative ode, Title 25, Chapter I, Subchapter 1, Article 5. This standard will ake an important contribution to improving housing in the State, but ue to the unique characteristics of the Davis climate, the State egulations are deemed to be inadequate for use in the City of Davis.

C. Many years of research 1/ at the University of California t Davis have established the following facts:

(1) An experimental room with large windows facing west egularly achieved temperatures in excess of 140°F during the summer in avis. 2/ The problem of unshaded windows is inadequately dealt with in he State code. Consequently, dwellings which will overheat to such an xtent that they are unfit for human habitation may be built under the tate standard.

1/ See Research Bibliography.

2/ R. D. Cramer and L. W. Neubauer, "Solar Radiant Gains Through Directional Glass Exposure", American Society of Heating, Refrigeration and Air Conditioning Engineers, 1958; presented at Lake Placid, New York, June 22-29, 1959; ASHRAE Transactions (1959), Vol. 65, No. 59, p. 499.

(2) It has been found in experimental structures in Davis that solar heat gains from properly oriented windows can significantly reduce the need for heating in the winter. 3/ This factor is not credited in the State code.

(3) It has been found that the thermal capacity or heat storage ability of the building itself can help to ameliorate daily temperature extremes of both summer and winter. 4/ This factor is not accounted for in the State code.

D. From 1973 to 1975 the City of Davis commissioned a study which corroborated the experimental results described above by extensively studying the performance of actual buildings in Davis. 5/ It was found that: Both the thermal performance and actual energy use were examined.

(1) Some dwellings became dangerously hot (100-110°F) in the summer due to direct solar heat gains through large east or west facing windows, while identical dwellings with north or south facing windows remained comfortably cool (75-80°F) and, therefore, used substantially less energy for cooling.

(2) Dwelling units with south windows exposed to winter sun were significantly warmer during the winter (over 10°F warmer on cold, sunny days) and used significantly less energy for heating than dwelling units with windows facing other directions.

(3) Some dwelling units with windows on only one side had no through ventilation and would not cool at night even on cool, windy, summer evenings, thereby requiring expensive cooling system operation.

E. As part of the above mentioned study, the Davis climate was examined in light of the needs for energy conservation and the following findings were made:

(1) The daytime maximum temperature during July, the hottest month of the year, averages 95°F; however, the nighttime minimum averages 55.3°F. These nighttime lows are caused by thermally induced sea breezes originating over the Pacific Ocean which flow into portions of the Central Valley through the Carquinez Straits. 6/ These local

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3/ L. W. Neubauer, "Shapes and Orientations of Houses for Natural Cooling", Transactions of the American Society of Agricultural Engineers, Vol. 15, No. 1, pp. 126, 127, 128 (1972).

4/ R. D. Cramer and Loren W. Neubauer, "Thermal Effects of Floor Construction", ASHRAE Journal (January, 1961), six pages.

5/ Jonathan Hammond, Marshall Hunt, Richard Cramer and Loren Neubauer, A Strategy for Energy Conservation (1974).

6/ University of California Agriculture Extension Service, The Climate of Yolo County (1971).

climatic factors were found to all but eliminate need for summertime air conditioning in residential buildings if the following conditions are met:

(a) The windows are protected from direct solar radiation;

(b) The walls, floors and ceilings are adequately insulated;

(c) Adequate thermal storage capacity is provided within the structure; and

(d) Cross-ventilation for summer nighttime cooling is provided.

(2) During January, the coldest winter month, the average 24-hour outside temperature is 45.3°F. 7/ On the average, Davis receives sun for fifty-six percent (56%) of the time possible during the five winter months. The frequency and duration of winter sunshine is such that the need to heat residential buildings is substantially reduced if the following conditions are met:

(a) The walls, floors and ceilings are adequately insulated;

(b) Adequate south-facing glass exposed to the winter sun is provided; and

(c) Adequate thermal storage capacity is provided within the insulated shell of the structure.

F. Due to the above stated factors, it has been found that:

(1) Considerably better minimum performance levels can be required in Davis than provided for by the State code without unduly restricting designs and raising costs, or requiring new technologies.

(2) The present State code allows the construction of buildings that will be unfit for human habitation in the event of the interruption in gas or electrical service during one of the frequently occurring hot or cold weather events. Therefore, the present State code, by its failure to adequately address the heat loss and heat gain considerations of glazing and glazing orientation, does not adequately deal with the Davis climatic conditions.

(3) Considerable reduction in the real cost of housing can be achieved in buildings with good thermal performance by lowering utility bills. In addition, the initial costs of improving the structure's thermal performance is usually offset by the resultant savings due to the smaller capacity heating and/or cooling equipment required for a thermally efficient structure.

7/ Ibid.

Section 2. Definitions.

The following words and phrases shall have the meanings respectively ascribed to them by this section:

A. "Winter Design Day" shall refer to a day upon which it shall be assumed, for purposes of structural heat loss calculations, that all of the following climatological conditions exist:

(1) The sun's path and resultant angles of direct sunlight shall be those which occur on December 21 of each year at latitude 38° 32' North. These angles can be approximated by using latitude 40° North data. (See Table 1.)

(2) The sun's intensity through glazing shall be calculated for December 21 of each year at latitude 38° 32' North; this can be approximated by using latitude 40° North data. (See Table 1.)

(3) The 24-hour average outside temperature is 45°F.

(4) For the sake of determining the external air film coefficient, the wind speed shall be assumed to be 15.0 m.p.h. in accordance with ASHRAE procedures.

B. "Summer Design Day", as used in this ordinance, shall refer to a day upon which it shall be assumed, for purposes of structural heat gain calculations, that all of the following climatological conditions exist:

(1) The sun's path and resultant angles of direct sunlight shall be those which occur on August 21 of each year at latitude 38° 32' North. These angles can be approximated by using latitude 40° North. (See Table 1.)

(2) The sun's intensity through glazing shall be calculated for August 21 of each year at latitude 38° 32' North; this can be approximated by using latitude 40° North data. (See Table 1.)

(3) The outside temperatures on August 21 shall be assumed to be, at each hour, Pacific Standard Time, as follows:

Time A. M.	Temp. °F	Time P. M.	Temp. °F
1:00	66	1:00	95
2:00	64	2:00	99
3:00	61	3:00	100
4:00	60	4:00	99
5:00	59	5:00	98
6:00	59	6:00	95
7:00	67	7:00	91
8:00	72	8:00	87
9:00	78	9:00	81
10:00	82	10:00	77
11:00	87	11:00	73
12:00	91	12:00	68

(4) For the sake of determining the exterior air film coefficient, the wind speed shall be 15 m.p.h. in accordance with ASHRAE procedures.

C. "Floor Area" shall refer to the total habitable area of a dwelling unit (expressed in square feet) which is within the exterior face of the insulated shell of the structure and which is heated or cooled.

Section 3. Minimum Performance Standards Adopted.

The City of Davis hereby adopts minimum standards for the thermal performance of buildings to be constructed within the City of Davis. In order to achieve maximum thermal performance, the performance standards have been carefully adjusted to the special problems and opportunities of the Davis climate. These standards shall apply to all residential structures designated Group H and Group I in the Uniform Building Code.

A. Winter Performance Standard. For a winter performance standard the Total Days Heat Loss per square foot of floor area during the winter design day shall be as follows: For single-family, detached structures designated U.B.C. Group I, see Table 2; for multiple dwellings, U.B.C. Group H, the Total Days Heat Loss shall not exceed one hundred twenty (120) BTU's per square foot of floor area. Commonwall Group I structures shall meet Group H standards. The resolution establishing methods of compliance with the performance standards will allow for numerically increasing the permissible standard on the basis of surface areas in common in order to equitably deal with the variability which occurs in this class of dwelling units.

B. Summer Performance Standard. For a summer performance standard, the Total Days Heat Gain per square foot of floor area during the Summer Design Day shall be as follows: For single-family, detached structures, U.B.C. Group I, see Table 2; for multiple dwellings U.B.C. Group H, the Total Days Heat Gain shall not exceed forty (40) BTU's per square foot of floor area. Commonwall Group I structures shall meet Group H standards. The resolution establishing methods of compliance with the performance standards will allow for numerically increasing the permissible standard on the basis of surface areas in common in order to equitably deal with the variability which occurs in this class of dwelling units.

Section 4. Methods of Compliance with Performance Standards to be Established by Resolution.

Standard methods for calculating the performance of a proposed structure to determine compliance with the standards of this ordinance shall be adopted by resolution of the City Council.

Section 5. Administration and Enforcement.

A. The provisions of this ordinance and the resolution establishing the methods of compliance shall be administered by the Building Official of the City of Davis.

B. No building permit shall be issued by the Building Official for any new structure subject to this ordinance unless such structure is found to be in compliance with the winter and summer performance standards hereby established.

Section 6. Partial Exemption.

Structures designated U.B.C. Group I to be built on lots which are unimproved with structures and for which a tentative subdivision map has been approved prior to September 1, 1974, shall be exempt from glazing shading requirements adopted by resolution pursuant to Section 4 of this ordinance. To the extent that the exemption from glazing shading requirements causes a structure to exceed the performan standards established by Section 3 of this ordinance, such incremental excess shall be permitted.

Section 7. Partial Exemption.

Structures designated U.B.C. Group I to be built on lots whic are unimproved with structures and for which a tentative subdivision ma has been approved prior to January 1, 1976, but after September 1, 1974 and which lots front upon a portion of street having an axis between 292.5° and 067.5° true (N67.5°W and N67.5°E) and 247.5° and 112.5° true (S67.5°W and S67.5°E), shall be exempt from glazing shading requirement adopted by resolution pursuant to Section 4 of this ordinance. To the extent that the exemption from glazing shading requirements causes a structure to exceed the performance standards established by Section 3 of this ordinance, such incremental excess shall be permitted.

Section 8. Variances.

A. Purpose. The purpose of a variance is to allow variatio from the strict application of the requirements of this ordinance and implementing resolutions where, by reason of the exceptional narrowness shallowness or unusual shape of a specific piece of property, or other extraordinary situation or condition of such piece of property, or of the use or the development of property immediately adjoining the property in question, the literal enforcement of the requirements of this ordinance would involve practical difficulties or would cause und hardship unnecessary to carry out the spirit and purpose of this ordinance. In most cases, the variance shall only relate to the allowable area of unshaded glazing permissible under the resolutions implementing this ordinance.

B. Application. Application for a variance shall be made b the property owner or the Board of Building Appeals or the Community Development Director on a form prescribed by the City, and shall be accompanied by a fee as prescribed by resolution adopted pursuant to City Code Section 29-12.1, no part of which shall be refundable. No fee shall be charged if the variance is initiated by the Board of Building Appeals or the Community Development Director.

C. Maps and Drawings. Maps and drawings required to demonstrate that the conditions set forth in this ordinance apply to the subject property, together with precise and accurate legal descriptions and scale drawings of the property and existing buildings, and other data required, shall be submitted with the application for a variance.

D. Grounds for Granting. The Board of Building Appeals may grant a variance only when all of the following conditions are found:

(1) That any variance granted shall be subject to such conditions as will assure that the adjustment thereby authorized shall not constitute a grant of special privilege inconsistent with the limitations upon other similarly situated properties which were developed under the limitations of this ordinance.

(2) That because of special circumstances applicable to the subject property, the strict application of this ordinance is found to deprive subject property of privileges enjoyed by other similar properties which were developed under the limitations of this ordinance.

(3) That the authorizing of such variance will not be of substantial detriment to adjacent property, and will not materially impair the purposes of this ordinance or the public interest.

(4) That the condition or situation of the subject property or the intended use of the property for which the variance is sought is not so general or recurrent in nature as to make reasonable or practicable the formulation of a general regulation for such conditions or situations.

(5) That there are not available reasonable alternative construction methods which will bring the proposed structure into compliance with the performance standards of this ordinance.

E. Grounds for Granting--Examples. The following types of physical or topographical factors are examples of conditions which may justify the grant of a variance from the glazing shading requirements to be established by resolution as provided by Section 4 of this ordinance:

(1) Overriding off-site view considerations which are determined to add appreciable incremental value to the subject property.

(2) Minimum size lots with fixed and adverse orientation problems.

(3) Adverse lot orientation dictated by street or utility improvements or similar physical limitations where such limitations are in existence prior to the adoption of this ordinance.

F. State Standards. No variance shall be granted under thi section which will result in a structure which exceeds the then existing State of California residential energy conservation standards.

G. Notice of Variance Hearing. Upon the filing of an appea the Building Official shall provide written notice of the filing of th appeal to all persons interested in the matter and shall cause notice of public hearing to be published in a newspaper of general circula tio

H. Review of the Decision. The decision of the Board of Building Appeals to grant or deny the application shall be subject to appeal in accordance with the resolution establishing the Board of Building Appeals.

Section 9. Appeals.

Any person aggrieved by a determination of the Building Official in the application of this ordinance may appeal such determination to the City of Davis Board of Building Appeals. Such appeal shall be in writing and shall be filed with the Building Official within fifteen (15) days of the determination appealed. All appeals shall be accompanied by payment of a fee in the amount set forth in the City's Community Development fee schedule.

Upon the filing of an appeal, the Building Official shall provide written notice of the filing of the appeal to all persons interested in the matter and shall cause notice of public hearing to be published in a newspaper of general circulation.

In consideration of an appeal, the Board of Building Appeals shall have authority to determine the suitability of alternate materials and methods of construction and to provide for reasonable interpretation of the provisions of this ordinance and implementing resolutions, provided, however, that no alternate material nor method of construction shall be approved which results in a reduction in the performance standards established by this ordinance for both summer and winter conditions.

The decision of the Board of Building Appeals shall be subject to appeal in accordance with the resolution establishing the Board of Building Appeals.

Section 10. Tables.

TABLE 1

Table 4 .... Solar Position and Intensity; Solar Heat Gain Factors* for 40 Deg North Latitude

Date	Solar Time A.M.	Solar Position Alt.	Solar Position Azimuth	Direct Normal Irradiation, Btuh/sq ft	N	NE	E	SE	S	SW	W	NW	Hor.	Solar Time P.M.
Aug 21	6	7.9	99.5	80	12	67	82	48	5	5	5	5	11	6
	7	19.3	90.0	181	17	138	191	135	17	10	15	16	82	5
	8	30.7	79.9	236	23	128	218	180	40	22	22	22	122	4
	9	41.8	67.9	259	28	82	197	186	79	28	28	28	176	3
	10	51.7	52.1	271	32	40	149	187	118	34	32	32	213	2
	11	59.3	29.7	277	34	35	81	158	140	52	34	34	238	1
	12	62.3	0.0	279	35	38	38	105	148	105	38	35	247	12
		Half Day Totals			161	503	936	961	471	202	154	153	945	
Dec 21	8	5.5	53.0	88	2	7	67	83	48	3	2	2	8	4
	9	14.0	41.9	217	9	10	138	205	162	13	9	9	39	3
	10	20.7	29.4	261	14	14	113	232	210	65	14	14	77	2
	11	25.0	15.2	279	18	18	56	217	243	120	18	18	107	1
	12	26.6	0.0	284	17	17	18	177	253	177	18	17	112	12
		Half Day Totals			49	64	380	831	781	273	50	48	282	
					N	NW	W	SW	S	SE	E	NE	HOR.	← P.M.

summer

winter

* Total solar heat gains for DS (⅛ in.) sheet glass. Based on a ground reflectance of 0.20 and values in Tables 1 and 9.

From Handbook of Fundamentals, 1972, American Society of Heating, Refrigeration and Air Conditioning Engineers.

TABLE 2 7/

DETACHED GROUP I DWELLING UNIT THERMAL STANDARDS

Floor Area (sq.ft.)	Winter Heat Loss (BTUs/[sq.ft.][day])	Summer Heat Gain (BTUs/[sq.ft.][day])
500	363	118
1000	239	103
1500	208	98
2000	192	95
2500	182	93
3000	176	91

NOTE: Direct interpolation shall be used for floor areas not shown.

7/ Infiltration and internal heat production are not considered under the requirements of these standards. These are very important considerations in the real performance of a building and must be estimated when sizing heating and cooling devices whether conventional or solar. However, for the present purpose they are too variable to be standardized.

Section 11. Conflicting Ordinances Repealed.

All ordinances or portions of ordinances which conflict with the provisions of this ordinance are, to the extent of such conflict, hereby repealed.

Section 12. Effective Date.

This ordinance shall become effective on and after the ninetieth (90th) day following its adoption.

PASSED AND ADOPTED by the City Council of the City of Davis on this 15th day of October, 1975, by the following vote:

AYES : Councilmen Black, Holdstock, Stevens, Tomasi, Mayor Poulos.

NOES : None.

ABSENT: None.

JOAN G. POULOS
Mayor

ATTEST:

HOWARD L. REESE
City Clerk

BIBLIOGRAPHY OF PAST RESEARCH ON THE
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1. Cramer, R. D., R. B. Deering, Virginia Gould Koy and L. W. Neubauer, "Temperature Control for Houses", Journal of Home Economics, Vol. 50, No. 3 (March, 1958).

2. Cramer, R. D. and Loren W. Neubauer, "Diurnal Radiant Exchange With The Sky Dome", Solar Energy, Vol. IX, No. 2 (April-June, 1965), pp. 95-103.

3. Cramer, R. D. and Loren W. Neubauer, "Thermal Effects of Floor Construction", ASHRAE Journal (January, 1961), six pages.

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7. Deering, R. B., "Effective Use of Living Shade", California Agriculture (September, 1955), pp. 10, 11 & 15.

8. Deering, R. B., "The Importance of Microclimatic Problems in Garden Design", The National Horticultural Magazine (October, 1953), pp. 226-230.

9. Deering, R. B. and F. A. Brooks, "The Effect of Plant Material Upon The Microclimatic of House and Garden", The National Horticultural Magazine (July, 1954), pp. 162-167.

10. Everson, G. F., L. W. Neubauer and R. B. Deering, "Environmental Influence on Orientation and House Design to Improve Living Comfort", Journal of Home Economics, Vol. 48, No. 3 (March, 1956), pp. 161-167.

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12. Neubauer, L. W., "Optimum Alleviation of Solar Stress on Model Buildings", Transactions of the American Society of Agricultural Engineers, Vol. 15, No. 1 (1972), pp. 129, 130, 131, 132.

13. Neubauer, L. W., "Orientation and Insulation: Model versus Prototype", Transactions of the American Society of Agricultural Engineers, Vol. 15, No. 9 (1972), pp. 707, 708, 709.

14. Neubauer, L. W., "Shapes and Orientations of Houses for Natural Cooling", Transactions of the American Society of Agricultural Engineers, Vol. 15, No. 1 (1973), pp. 126, 127, 128.

15. Neubauer, L. W. and R. D. Cramer, "Effect of Shape of Building on Interior Air Temperature", Transactions of the American Society of Agricultural Engineers, Vol. 11, No. 4 (1968), pp. 537, 538 & 539.

16. Neubauer, L. W. and R. D. Cramer, "Shading Devices to Limit Solar Heat Gain But Increase Cold Sky Radiation", Transactions of the American Society of Agricultural Engineers, Vol. 8, No. 4 (1956), pp. 470, 471, 472 & 475.

17. Neubauer, L. W., R. D. Cramer, and Melvin Laraway, "Temperature Control of Solar Radiation on Roof Surfaces", Transactions of the American Society of Agricultural Engineers, Saint Joseph, Michigan, Vol. 7, No. 9 (1964), pp. 432, 433, 434 & 438.

18. University of California Agriculture Extension Service, The Climate of Yolo County (1971).

ORDINANCE NO. 787

ORDINANCE AMENDING SECTION 6 OF ORDINANCE NO. 784 (ORDINANCE ESTABLISHING ENERGY CONSERVATION PERFORMANCE STANDARDS FOR RESIDENTIAL CONSTRUCTION WITHIN THE CITY OF DAVIS) RELATING TO ENERGY CONSERVATION PERFORMANCE STANDARDS FOR RESIDENTIAL CONSTRUCTION ON LOTS CREATED PRIOR TO SEPTEMBER 1, 1974

THE CITY COUNCIL OF THE CITY OF DAVIS DOES HEREBY ORDAIN AS FOLLOWS:

SECTION 1. Section 6 of Ordinance No. 784 is hereby amended to provide as follows:

Section 6. Partial Exemption.

Structures designated U.B.C. Group I to be built on lots which are unimproved with structures and for which a tentative subdivision map has been approved prior to September 1, 1974, shall be exempt from requirements adopted by resolution pursuant to Section 4 of this ordinance. To the extent that the exemption from requirements causes a structure to exceed the performance standards established by Section 3 of this ordinance, such incremental excess shall be permitted.

SECTION 2. This ordinance shall become effective concurrently with Ordinance No. 784.

PASSED AND ADOPTED by the City Council of the City of Davis on this 5th day of November, 1975, by the following vote:

AYES : Councilmen Black, Holdstock, Stevens, Tomasi, Mayor Poulos.

NOES : None.

ABSENT: None.

JOAN G. POULOS
Mayor

ATTEST:

HOWARD L. REESE
City Clerk

RESOLUTION NO. 1833, S...

RESOLUTION ADOPTING PROCEDURES FOR COMPLIANCE WITH THE ENERGY CONSERVATION PERFORMANCE STANDARDS FOR RESIDENTIAL CONSTRUCTION WITHIN THE CITY OF DAVIS

WHEREAS, the City of Davis has, by ordinance, established certain energy conservation performance standards for new residential construction within the City of Davis; and

WHEREAS, the ordinance which establishes energy conservation performance standards provides that standard methods for determining compliance of proposed buildings shall be established by resolution;

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Davis as follows:

Section 1. Application.

Compliance with the energy conservation performance standards established by the City of Davis shall be determined by reference to the provisions of this resolution and any amendments thereto.

Section 2. Definitions.

For purposes of this resolution and the energy conservation performance standards ordinance of the City, the following words and phrases shall have the meanings respectively ascribed to them by this section:

A. R Values. (1/U = R) Thermal Resistance (R) is the measure of the resistance of a material or building component to the passage of heat. The units of measurement are: (Hours) (Degrees Fahrenheit) (Square Feet)/BTU. The resistance value (R) of mass-type insulations shall not include any value for reflective facing. (NOTE: For reflective foil insulation, use ASHRAE procedures only. Calculate both the winter and summer composite resistance value and use whichever is less.)

B. Composite Thermal Resistance (R_t) is the sum of each of the resistance values of the parts of an assembly of materials which together form an external skin element of the structure. For example, a commonly used wall is one which has an interior air film, one-half (1/2) inch thick plaster board, three and one-half (3-1/2) inches batt insulation, stucco, and finally, an exterior air film, all of which have R values which are added together to derive the R_t value for the wall element.

C. Orientation. The compass directions are designated as follows when the attached tables are used:

North	337.5° - 022.5°
Northeast	022.5° - 067.5°
East	067.5° - 112.5°
Southeast	112.5° - 157.5°
South	157.5° - 202.5°
Southwest	202.5° - 247.5°
West	247.5° - 292.5°
Northwest	292.5° - 337.5°

D. Exterior Surface Area. The area for each dwelling unit of walls, ceilings, suspended floors, glazing, doors, etc. enclosing conditioned spaces and exposed to ambient climatic conditions.

E. Heavy Exterior Building Elements. The walls, suspended floors and/or ceilings which contain a heat storage capacity of 30 BTU's/Day for each square foot of surface area are considered to be heavy (see definition K). Only those materials located on the interior side of insulation materials may be counted. (An eight [8] inch thick light-weight concrete block wall with exterior insulation slightly exceeds these requirements.)

F. Color. Surfaces with a Munsell lightness value of 6.0 to 10.0 are to be considered light in color. Surfaces with a Munsell lightness value of 9.0 to 10.0 are to be considered very light in color. Unpainted wood surfaces are to be considered light in color. The Building Inspector shall prepare two (2) representative collections of materials and surface covering materials, one with Munsell lightness values greater than 6 and one of materials with Munsell lightness values greater than 9. These collections shall be available for inspection by the public.

G. Glazing. All vertical, horizontal, and tilted translucent or transparent exterior building elements shall be considered glazing with a thermal resistance and daylight transmittance as specified by the manufacturer or as calculated by ASHRAE methods or other reliable references or procedures.

H. Shading Coefficient. The ratio of the solar heat gain through a shading-glazing system to that of an unshaded single-pane of double strength window glass under the same set conditions.

I. Hour's Solar Heat Gain. The amount of energy transmitted through an area of glazing oriented to a particular direction in one (1) hour. The following formula is used for calculation:

HSHG = (SC) (SHGF) (A)

Where:

HSHG = Solar Heat Gain through the glazing for one (1) hour (BTU's/hour)

SC = Shading Coefficient

SHGF = Solar Heat Gain Factor for the hour from attached Table 1 (BTU's/square foot of glazing) using December 21 for winter and August 21 for summer.

A = Area in square feet of glazing exposed to the sun (square feet).

J. Solar Heat Gain Factor. The number of BTU's of solar energy transmitted through one (1) square foot of clear 1/8-inch glass in one (1) hour. This is determined by using the attached Table 1 which applies to 40° North latitude and the eight (8) compass orientations (see definition C).

K. Heat Storage Capacity. The mass located inside the insulated shell of the structure that fluxes through a temperature cycle each day in summer and winter, absorbing heat during overheated periods and storing it for release during underheated periods. Heat storage capacity shall be estimated by the following procedure:

$$HS = (WM)(SH)(\Delta T)$$

Where:

HS = Heat Storage Capacity (BTU's/Day)

WM = The weight of the materials (lbs.) inside the insulated shell of the building to a depth yielding a resistance of R-1, except in the case of slab floors where only the slab itself is credited.

SH = Specific Heat of those materials (BTU's/[lb.] [degree F])

ΔT = Temperature flux; 5°F will be the maximum allowable for calculation purposes, except that light weight frame construction will be allowed to flux 10°F. (In order to determine the heat or cold available for storage, see Path II, Section 5.)

This total stored heat may be subtracted from the day's heat loss or gain to yield the adjusted Total Day's Heat Loss or Total Day's Heat Gain. Mass located in exterior elements to which the Equivalent Temperature Differential Method (E.T.D.) is applied to calculate summer heat gain shall not be included in the summer heat storage capacity credit.

L. Floor Area. Total habitable area of a dwelling unit (expressed in square feet) which is within the exterior face of the insulated shell of the structure and which is heated or cooled.

M. Accepted References. The following are useful and acceptable references:

Handbook of Fundamentals 1972, American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE), N. Y., N. Y., 1972.

Architectural Graphic Standards, Charles G. Ramsey and Harold R. Sleeper, John Wiley & Sons, Inc., N. Y., N. Y., Sixth Edition, 1970.

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Concepts in Thermal Comfort, David Egan, Tulane University, School of Architecture, New Orleans, Louisiana, 1972.

Thermal Design of Buildings, Tyler Stuart Rogers, John Wiley & Sons, Inc., N. Y., N. Y., 1964.

Sun Angle Calculator, Libbey-Owens-Ford Company, Toledo, Ohio, 1975.

Energy Design Manual for Residential Buildings, State of California, Department of Housing and Community Development, Division of Codes and Standards, Sacramento, California, 1975.

Section 3. Standard Methods of Building Performance Calculation.

A. There are hereby adopted two (2) alternative standard methods of determining compliance with the City of Davis energy conservation performance standards. The two (2) alternative standard methods shall be referred to as Path I and Path II approaches.

B. Structures utilizing either Path I or Path II shall comply with the following:

(1) Infiltration. All swinging doors and windows opening to the exterior or to unconditioned areas such as garages shall be fully weatherstripped, gasketed or otherwise treated to limit infiltration. All manufactured windows and sliding glass doors shall meet the air infiltration standards of the 1972 American National Standards Institute (A134.2, A134.3 and A134.4), when tested in accordance with ASTM E 283-73 with a pressure differential of 1.57 lbs./ft.^{2} and shall be certified and labeled.

(2) Loose Fill Insulation. When blown or poured type loose fill insulation is used in attic spaces, the slope of the roof shall be not less than 2-1/2 feet in 12 feet and there shall be at least 30 inches of clear headroom at the roof ridge. ("Clear headroom" is defined as the distance from the top of the bottom chord of the truss

or ceiling joists to the underside of the roof sheathing.) When eave vents are installed, adequate baffling of the vent opening shall be provided to deflect the incoming air above the surface of the material and shall be installed at the soffit on a 45-degree angle. Baffles shall be in place at the time of framing inspection. When loose fill insulation is proposed, the R value of the material required to meet these regulations shall be shown on the building plans or calculation sheet.

(3) Pipe Insulation. All steam and steam condensate return piping and all continuously circulating domestic or heating hot water piping which is located in attics, garages, crawl spaces, underground or unheated spaces other than between floors or in interior walls shall be insulated to provide a maximum heat loss of 50 BTU/hr. per linear foot for piping up to and including 2-inch and 100 BTU/hr. per linear foot for larger sizes. Piping installed at depth of 30 inches or more complies with these standards.

Section 4. Path I (Prescriptive Method).

Buildings meeting all of the following criteria will fulfill the required energy conservation aspects of this code with no overall performance calculations required.

Calculations using the applicable method outlined in Path II may be employed to demonstrate compliance of alternatives to any particular section of Path I. Thermal trade-offs between sections of Path I must be done by using Path II or by referring to approved thermal trade-offs table developed by the Building Inspector.

A. Walls. All exterior walls (excluding windows and doors) shall use R-11 batt insulation between studs. Group H structures must have light colored walls or shaded walls. Fifteen percent (15%) of the wall area may be dark colored to allow for trim and color accents. (Group I structures have no wall color requirement.)

Exceptions:

(1) All exterior walls shall achieve a composite resistance value (Rt) of 10.52 if the insulation is not penetrated by framing, and Rt of 12.50 if the insulation is penetrated by the framing or furring. (California Administrative Code, Title 25, Chapter 1, Subchapter 1, Article 5, Section 1094[a].)

(2) Heavy walls with exterior insulation not penetrated by furring or framing shall have an Rt of 7.36, and Rt of 8.75 if the insulation is penetrated by furring or framing.

(3) Group H structures with dark colored walls shall increase their applicable Rt requirements by twenty percent (20%).

B. Roof/Ceilings; Ceiling/Attics. All roof/ceilings and ceiling/attics must use insulation achieving a minimum resistance of R-19 for the insulation itself. Group H occupancies having roof surfaces unshaded on August 21, at 8:00 a. m., 12:00 noon, or 4:00 p. m., shall be no darker than No. 6 on the Munsell color chart. Unshaded roof areas on Group I occupancies shall be no darker than No. 4 on the Munsell color chart. Roofs having unshaded areas and color darker than No. 6 or No. 4 respectively must increase the total insulation to yield R25 for the insulation itself.

Exceptions:

(1) All roof/ceilings and/or ceiling/attics sections shall achieve a composite resistance value (Rt) of 16.67 if the insulation is not penetrated by framing or furring and Rt of 20.0 if the insulation is penetrated by the framing or furring. (California Administrative Code, Title 25, Chapter 1, Subchapter 1, Article 5, Section 1094[c].) Blown insulation (loose fill type) shall be considered to be penetrated by the framing.

(2) The roof/ceiling and/or ceiling/attic sections of the dwelling unit as a whole may be insulated to values greater and/or less than required in (1) above if the resulting heat loss equals or is less than that which would occur if the values required in (1) above were met, or if the thermal resistance values of the ceiling areas satisfy the following equation:

$$1/Rt \text{ required} = (\text{Area A/Total Area})(1/Rt \text{ achieved}) + (\text{Area B/Total Area})(1/Rt \text{ achieved}) + \ldots + (\text{Area N/Total Area})(1/Rt \text{ achieved})$$

(3) In Group H occupancies, roof/ceilings or ceiling/attics located beneath dark colored roofs shall achieve composite resistance values (Rt) 30% greater than the values in (1) and (2) above, i. e., Rt = 21.67 and Rt = 26.00 respectively. In Group I occupancies, roof/ceilings or ceiling/attics located beneath roofs that are darker than Munsell Color No. 4 shall achieve composite resistance values (Rt) 30% greater than the values in (1) and (2) above, i. e., Rt = 21.67 and Rt = 26.00 respectively.

C. Floors. Suspended floors over a ventilated crawl space or other unheated space shall have insulation with a minimum resistance of R-11. Concrete slabs on grade require no insulation.

Exceptions:

(1) Suspended floors over an unheated space shall achieve a composite resistance value (Rt) of 10.52 if the insulation is not penetrated by framing, and Rt of 12.50 if the insulation is penetrated by framing.

(2) Heavy suspended floors with exterior insulation shall achieve a composite resistance value (Rt) of 7.36 for insulation not

penetrated by framing members, and Rt of 8.75 for insulation penetrated by framing members.

D. Glazing Area. In Group H occupancies, exterior single-pane glazing (windows, skylights, etc.) may not exceed 12-1/2% of the floor area. Exterior double-pane glazing may not exceed 17-1/2% of the dwelling unit's floor area. In Group I occupancies, a glazing constant of 20 square feet in single-pane glazing and 28 square feet in double-pane glazing may be added to the percentage figures allowed above.

Exceptions:

(1) A combination of single and double-pane glazing may be used so long as the area of the single plus the area of the double glazing divided by 1.4 is not greater than 12-1/2% (plus 20 square feet for Group I occupancies) of the dwelling unit's floor area.

(2) A combination of single and/or double-pane glazing with interior shutters may be used to increase the allowed glazing provided that:

(i) The interior shutters are of a permanent construction and installed so that they are operable, and tight fitting or weatherstripped so that a seal is created.

(ii) The areas in each treatment do not exceed those allowed by the following procedure:

$$GC + (FA)(.125) = Area_s + (Area_D)(.64) + (Area_{shut})/Rt$$

Where:

GC = Glazing constant (square feet) taken at 20 square feet in Group I and zero in Group H occupancies.

FA = Floor Area (square feet).

$Area_s$ = Area in single-pane glazing (square feet).

$Area_D$ = Area in double-pane glazing (square feet).

$Area_{shut}$ = Area in interior shuttered glazing (square feet).

Rt = The composite resistance of the shutter-glazing systems.

(3) When the area of glazing allowed by application of (1) or (2) is exceeded, the excess area will be considered justified if all the following conditions are met:

(i) Glazing must be south facing. If it is mounted other than vertically, it must be tilted at least 30° up from the horizontal to face south.

(ii) It must be clear. (Shading coefficient numerically greater than or equal to .80 for the glazing itself.)

(iii) It must receive full direct sun from 10:00 a. m. to 2:00 p. m. (P. S. T.) on December 21.

(iv) For each square foot of glazing being justified, the building must contain a heat storage capacity (HS) equivalent to 750 BTU's/Day, located inside the insulated shell of the structure, and not covered with insulation materials such as carpet yielding an Rt of 1.0 or greater. The following will allow a quick method for calculation of mass needed for each square foot of exempted glazing:

59 Square feet of interior stud partition wall (2" x 4"s - 16" o.c. with 1/2" gypsum two sides).

117 Square feet of exterior stud wall or ceiling (2" x 4"s - 16" o.c. with 1/2" gypsum inside, insulation, and various external treatments).

21 Square feet of 8-inch lightweight concrete block masonry exterior wall insulated externally, cores filled for structural support only.

15 Square feet of concrete slab floor provided with a steel trowel finish, exposed aggregate, tile (vinyl, asbestos, or ceramic), terrazo, or hardwood parque not greater than 1/2-inch thick.

(NOTE: Lightweight stud frame walls are assumed to flux 10°F; heavy walls are assumed to flux 5°F. See Definitions E and K.)

E. Glazing Shading.

(1) All glazing which is not oriented to the north must be shaded to protect it from direct solar radiation for the hours of 8:00 a. m., 12:00 noon, and 4:00 p. m. (P.S.T.), August 21. Glazing facing SE or SW must also be checked for shading at 10:00 a. m. for SE and 2:00 p. m. for SW in addition to the standard three hours. For each check hour the area of glazing not shaded is calculated and accumulated. In Group H occupancies the total accumulated amount of unshaded glazing may not exceed 1.5% of the dwelling unit's floor area. In Group I occupancies the total accumulated amount of unshaded glass may not exceed 3% of the dwelling unit's floor area. Shading shall be demonstrated to the satisfaction of the Building Inspection Division of the Community Development Department. Drawings showing shadows cast by shading systems, or scale models suitable for use in the solar-ranger setup by the Building Inspection Division, or the use of approved shade screen systems may be employed to demonstrate compliance. Tinted, metalized, or frosted glass shall not be considered self-shading.

(2) Interior mounted shutters meeting the following specifications may be utilized to meet the shading requirements:

(i) The exterior oriented side must be very light in color (Munsell of 9.0 or greater) and flat.

(ii) The shutters must be tight fitting or all cracks or edges in the system must be weather stripped to create a seal.

(iii) The shutters must be opaque.

(iv) A composite resistance value of Rt = 1.0 for the shutters must be achieved.

(3) Exterior mounted shading systems meeting the following specifications may be utilized to meet the shading requirements:

(i) They shall be of permanent materials and construction. A permanent frame with sheathing having a life expectance of five years minimum must be provided and guaranteed by the builder.

(ii) For the required design hour, the shading device must be capable of intercepting 100% of the direct beam solar radiation, or provide a minimum shading coefficient of 0.2 or less. If the shading system at a design hour does not perform to these standards, then the portion of the glazing which is left exposed is to be calculated and added to the accumulated unshaded glazing total.

(4) Other types of shading systems are allowed if they comply with either of the following:

(i) All on-site and off-site obstructions to the sun, providing 80% attenuation of the direct solar beam, may be considered as external shading devices and may be accounted for in the summer shading calculations. (NOTE: If during the life of the structure the off-site obstructions to the sun used to achieve shading standards compliance are modified or removed, then the structure may be found to be in violation of the Code if other compensating obstructions to the sun or shading devices have not been deployed.)

(ii) A shading system may be temporary, provided that it is designed and constructed to function to the standards above and built to last until its function is replaced by plantings. Plan and elevation drawings must show expected plant configuration and accurately state the number of years required for the projected plant growth. Final occupancy permits shall not be issued until the specified plants are in place.

F. Ventilation for Summer Night Time Cooling. Where design of the dwelling unit is such that openable windows may only be provided along one elevation, mechanical cross ventilation must be installed to provide 15 air changes per hour ducted to the exterior.

Section 5. Path II (Performance Method).

Buildings regulated by the Residential Energy Conservation Code that do not meet the criteria of Path I must be calculated by a registered architect, engineer, building designer, or other qualified person to show that the proposed building will not exceed the standards set forth in Section 3 of Ordinance No. . The required calculation schedule is outlined below. (NOTE: More precise calculations may be submitted using ASHRAE or other comprehensive methods provided that the same design days are used.)

Commonwall U.B.C. Group I dwelling units may increase the permissible thermal standards for Heat Loss or Heat Gain using the following equation:

$$TS = TS_H + (TS_I - TS_H)(1 - SAC/[1.5][FA])$$

Where:

TS = The Thermal Standard which is applicable to the dwelling unit (BTU's/[sq. ft.][Day])

TS_H = The Thermal Standard for Group H structures (BTU's/[sq. ft.] [Day])

TS_I = The Thermal Standard for a detached Group I dwelling unit of the same floor area (BTU's/[sq. ft.][Day])

SAC = The Surface Area in Common with other dwelling units such as ceilings, walls, and floor (square feet)

FA = The dwelling unit's Floor Area (square feet)

A. Winter Calculations.

(1) The Total Day's Heat Loss shall not exceed the standards set in the Residential Energy Conservation Ordinance, Section 3.

(2) Winter heat loss calculations shall be based on the following formula:

TDHL = (DHL - SHGC)/(FA)

Where:

TDHL = Total Day's Heat Loss (BTU's/[sq. ft.][Day])

DHL = Day's Heat Loss (BTU's/Day)

SHGC = Solar Heat Gain Credit (BTU's/Day)

FA = Floor Area of dwelling unit (sq. ft.)

(3) The Design Day for sun angle considerations is December 21 at latitude 40°N or 38° 32' N. The outside daily temperature average for December and January is 45°F, yielding a 23°F difference between the inside (68°F) and the outside (45°F) average daily temperatures. The number of degree hours in the design day is the temperature difference times 24 hours or 552 for Davis. This figure is used as described in Paragraph (4)(i) below. (NOTE: This design, outdoor condition, is not intended to be for equipment sizing, but rather is meant to serve the purpose of performance design for energy conservation by more closely predicting the long term average conditions and energy use of the structure. Equipment sizing will require additional standard peak load calculations.)

(4) Calculation of Day's Heat Loss (DHL): Winter heat loss is determined by the composite resistance (Rt) of the exterior building surface to heat transfer to the outside air from the heated interior spaces.

DHL = HL + SHL

Where:

DHL = Day's Heat Loss (BTU's/Day)

HL = Heat Loss from outside surface elements (except slab) (BTU's/Day)

SHL = Slab on grade Heat Loss (BTU's/Day)

(i) The heat loss for all surfaces (except slabs on grade) facing the outside air or unheated spaces may be determined by the following formula:

$$HL = (A_1/Rt_1)(552) + (A_2/Rt_2)(552) + \ldots + (A_n/Rt_n)(552)$$

Where:

HL = Heat Loss from exterior surface element except a slab on grade (BTU's/Day)

A = Area of the exterior surface element (sq. ft.)

Rt = The element's composite thermal resistance ([hours] [Deg. F] [sq. ft.]/BTU)

552 = Davis Design Day Degree Hours ([Deg. F] [hours]/Day)

All exterior elements (walls, ceilings, doors and suspended floors) which are exposed to unheated enclosed or partially enclosed spaces shall be calculated as if they are exposed to outside conditions, or the temperature difference may be altered according to accepted ASHRAE procedures for surfaces adjacent to unheated spaces.

(ii) Concrete slab floors on grade lose heat in direct relation to the perimeter dimension in linear feet. The following formula applies:

SHL = (F) (P) (552)

Where:

SHL = Heat Loss from Slab (BTU's/Day)

F = The thermal conductivity of the edge of the slab with F = 0.81 (BTU/[foot] [hour] [Deg. F]) where no insulation is used and F = 0.55 where slab is insulated with edge insulation of R = 4.5 minimum. The insulation shall come within one inch of the top of the slab and extend sixteen inches below grade.

P = Perimeter dimension (feet)

552 = Davis Design Day Degree Hours ([Deg. F] [hours]/[Day])

(5) Calculation of Solar Heat Gain Credit (SHGC). Direct use of solar energy is dependent on the Day's Solar Heat Gain (DSHG) through the glazing, the Heat Storage (HS) characteristics of the

building, and the Solar Climatic Variable (SCV). The following steps are to be followed to calculate the SHGC:

(i) Calculate the Day's Solar Heat Gain (DSHG), by adding up the Solar Heat Gain for each daylight hour of December 21 design day for each square foot of glazing receiving sun.

$$DSHG = (HSHG_1 + HSHG_2 + \ldots + HSHG_n)\ (SCV)$$

Where:

DSHG = Day's Solar Heat Gain (BTU's/Day)

HSHG = Hour's Solar Heat Gain. HSHG is found according to the procedure described in Definition I. The number of hours added depends on the hours of sunlight on the glazing surface in question. (BTU's/hour)

SCV = Solar Climatic Variable (no units). SCV = 0.56 for Davis. This was determined by averaging the mean fraction of possible sunshine available for each month of the winter heating season (November, December, January, February, March).

(ii) Calculate the Heat Storage capacity of the building (HS). (See Definition K for calculation procedure.)

(iii) Then the Solar Heat Gain Credit (SHGC) (BTU's/Day) equals:

SHGC = DSHG or HS, whichever is less.

B. Summer Calculations.

(1) The Total Day's Heat Gain (TDHG) shall not exceed the standard set in the Residential Energy Conservation Ordinance, Section 3.

(2) Summer heat gain calculations shall be based on the following formula:

$$TDHG = (DHG - HS)/FA$$

Where:

TDHG = Total Day's Heat Gain (BTU's/[sq.ft.][Day])

DHG = Day's Heat Gain (BTU's/Day)

HS = Heat Storage (BTU's/Day)

FA = Floor Area of the dwelling unit (sq. ft.)

(3) The calculations below are based on the design day cited in the Residential Energy Conservation Ordinance taken at the five hours of 8:00 a.m., 10:00 a.m., 12:00 noon, 2:00 p.m., and 4:00 p.m.

(4) The Day's Heat Gain (DHG) is based on the weighted sum of calculations done at each of the five heat gain calculation hours (see equation [a] below). Structures without elevations oriented to the intercardinal directions may delete calculations for 10:00 a.m. and 2:00 p.m. and equally weigh the remaining three calculation hours by multiplying them by four (see equation [b] below). The following two weighted sum equations hold respectively.

$$(a)\quad DHG = ([HG_{8:00\ a.m.}][3]+[HG_{10:00\ a.m.}][2] +[HG_{12:00\ noon}][2]+[HG_{2:00\ p.m.}][2] +[HG_{4:00\ p.m.}][3])$$

or

$$(b)\quad DHG = ([HG_{8:00\ a.m.} + HG_{12:00\ noon} + HG_{4:00\ p.m.}] [4])$$

Where:

DHG = Day's Heat Gain (BTU's/[Day])

HG = Heat Gain at the hour calculated (BTU's/hour)

(NOTE: More detailed analysis of Heat Gain may be done by calculating each hour's heat gain for the daylight hours. The digits "2","3" and "4" in equations (a) and (b) above have the units of hours.)

(5) The Heat Gain (HG) may be calculated by using the following formula:

$$HG = WHG + OHG$$

Where:

HG = Heat Gain (BTU's/hour) at one of the design hours.

WHG = Heat Gain through Windows (BTU's/hour)

OHG = Heat Gain through Opaque surfaces (BTU's/hour)

(i) Heat Gain through Opaque surfaces. Calculations will be based on the Total Equivalent Temperature Differential Method (TETD) as described in ASHRAE Handbook of Fundamentals 1972, Chapter 22, pages 411-417. The TETD appropriate for the wall or roof section is found in attached Tables 2 and 3. Since the average Davis design day temperature is 5°F less than that used by ASHRAE, 5°F should be subtracted from the TETD values given in attached Tables 2 and 3 in accordance with ASHRAE procedures, as shown in the calculation below. (The interior temperature is assumed to be 75°F in accordance with ASHRAE.) The Heat Gain through Opaque surfaces is calculated as follows:

$$OHG = A_1(TETD-5)/Rt_1 + A_2(TETD-5)/Rt_2 + \dots + A_n(TETD-5)/Rt_n$$

Where:

OHG = Heat Gain through opaque surfaces at the calculation hour (BTU's/hour)

A = Area of the outside surface element (sq. ft.)

Rt = The element's composite thermal Resistance ([hours][Deg. F] [sq. ft.]/BTU)

TETD = The element's Total Equivalent Temperature Difference from attached Tables 2 and 3

(ii) Glazing. Summer Heat Gain through windows (WHG) shall be calculated using the following formula:

$$WHG = ([A][SC][SHGF]+[\Delta T][A]/Rt)_1 + (A \dots)_2 + \dots + (A \dots)_n$$

Where:

WHG = Direct solar heat gain plus conducted heat gain through windows at the calculation hour (must be done for each wall or roof section with glazing). (BTU's/hour)

A = Area of glazing surface being calculated (sq. ft.)

SC = Shading Coefficient (see Definition H). (Unitless)

SHGF = Solar Heat Gain Factor at the hour being calculated. (BTU's/[hours][sq. ft. of glazing])

Rt = Thermal Resistance of the glass (0.9 for single weight glass and 1.7 for double-pane). ([hours][Deg. F][sq. ft.]/BTU's)

ΔT = Difference between the outside and the inside temperatures, with 75°F being taken as the inside temperature. (Deg. F)

(6) Heat Storage Capacity (HS). Where the building design provides for ventilation in minimum conformance with Section 4 F, credit can be taken for the Heat Storage capacity of the structure. (NOTE: When calculating the heat storage capacity for the summer, no credit may be taken for exterior elements.)

Section 6. Fees.

The following schedule of fees shall be applicable for the checking of plans for conformity with the performance standards of the Residential Energy Conservation Code:

Path I	(No Exceptions)	No Charge
Path I	(Exercising Exceptions)	$20.00
Path II		$25.00

PASSED AND ADOPTED by the City Council of the City of Davis on this 15th day of October, 1975, by the following vote:

AYES : Councilmen Black, Holdstock, Stevens, Tomasi, Mayor Poulos.

NOES : None.

ABSENT: None.

JOAN G. POULOS
Mayor

ATTEST:

HOWARD L. REESE
City Clerk

TABLE 1

Solar Position and Intensity; Solar Heat Gain Factors* for 40 Deg North Latitude

	Date	Solar Time A.M.	Solar Position Alt.	Solar Position Azimuth	Direct Normal Irradiation, Btuh/sq ft	N	NE	E	SE	S	SW	W	NW	Hor.	Solar Time P.M.
Summer	Jun 21	6	7.9	99.5	89	12	87	82	48	5	5	5	5	11	6
		7	19.3	90.8	181	17	135	131	133	17	15	15	15	62	5
		8	30.7	79.3	236	23	128	216	180	40	22	22	22	122	4
		9	41.8	67.3	259	28	82	197	196	73	28	28	28	174	3
		10	53.7	52.1	271	32	40	140	187	128	34	37	32	213	2
		11	58.3	29.7	277	34	35	82	156	140	82	34	34	228	1
		12	62.3	0.0	279	35	35	38	105	149	105	38	35	247	12
				Half Day Totals		171	503	898	761	471	292	152	152	945	
Winter	Dec 21	8	5.5	53.0	88	2	7	67	62	40	3	2	2	5	4
		9	14.0	41.9	217	9	10	135	205	131	12	9	9	39	3
		10	20.7	28.4	262	14	14	113	232	220	55	14	14	77	2
		11	25.0	15.2	279	16	16	55	217	242	120	16	16	103	1
		12	26.6	0.0	284	17	17	18	177	253	177	18	17	113	12
				Half Day Totals		49	58	380	821	781	273	50	49	282	
						N	NW	W	SW	S	SE	E	NE	HOR.	← P.M.

* Total solar heat gains for DS (1/8 in.) sheet glass. Based on a ground reflectance of 0.20 and values in Tables 1 and 2.

From Handbook of Fundamentals, 1972, American Society of Heating, Refrigeration and Air Conditioning Engineers.

TABLE 2

Total Equivalent Temperature Differentials for Calculating Heat Gain Through Flat Roofs

Description of Roof Construction[a,b]	Wt, lb per sq ft	U value Btu/(hr)(ft²)(F°)	Sun Time A.M. 8 D	8 L	10 D	10 L	12 D	12 L	P.M. 2 D	2 L	4 D	4 L	6 D	6 L	8 D	8 L	10 D	10 L	12 D	12 L	2	8
Light Construction Roofs—Exposed to Sun																						
1" insulation + steel siding	7.4	0.213	25	11	65	31	90	48	95	53	78	45	42	27	8	6	1	1	−3	−3	1.0	0
2" insulation + steel siding	7.8	0.125	24	8	61	29	88	46	96	52	81	46	48	30	10	8	2	2	−3	−3	0.99	1
1" insulation + 1" wood[c]	8.4	0.206	12	2	47	21	77	39	92	50	86	48	61	35	25	16	7	5	0	−1	0.92	2
2" insulation + 1" wood[c]	8.5	0.122	6	0	41	18	72	36	90	48	88	49	65	36	30	19	9	7	1	0	0.93	2
1" insulation + 2.5" wood[c]	12.7	0.193	2	−2	25	8	48	23	70	35	79	43	71	40	50	29	29	17	15	9	0.73	3
2" insulation + 2.5" wood[c]	13.1	0.117	1	−2	19	6	43	20	65	33	76	41	72	40	53	31	33	20	18	11	0.63	4
Medium Construction Roofs—Exposed to Sun																						
1" insulation + 4" wood[c]	17.3	0.152	3	0	14	5	31	14	49	24	62	32	65	35	56	31	41	24	29	17	0.51	5
2" insulation + 4" wood[c]	17.8	0.113	6	1	12	4	25	12	43	22	55	30	62	34	56	31	42	25	32	18	0.48	5
1" insulation + 2" h.w. concrete	23.3	0.206	4	−1	27	11	54	25	74	39	81	44	70	40	48	27	24	15	12	7	0.75	3
2" insulation + 2" h.w. concrete	23.3	0.122	2	−2	23	9	49	23	70	36	79	43	71	40	49	28	28	17	15	9	0.73	3
4" l.w. concrete	17.3	0.213	1	−3	25	11	59	28	82	43	88	48	74	42	44	27	19	12	6	4	0.87	3
6" l.w. concrete	24.6	0.157	−2	−4	9	2	31	12	55	27	72	38	78	41	64	36	42	25	25	15	0.67	5
8" l.w. concrete	31.2	0.125	5	2	6	1	14	6	33	14	49	24	61	32	63	34	55	31	41	24	0.50	6
Heavy Construction Roofs—Exposed to Sun																						
1" insulation + 4" h.w. concrete	51.6	0.199	7	1	17	6	33	15	50	25	61	32	63	34	52	30	40	23	23	16	0.48	5
2" insulation + 4" h.w. concrete	52.1	0.120	7	2	15	6	30	13	46	23	58	30	61	33	54	30	41	23	31	17	0.46	5
1" insulation + 6" h.w. concrete	75.0	0.193	13	6	17	7	28	12	38	18	46	25	53	28	51	27	43	24	25	19	0.33	6
2" insulation + 6" h.w. concrete	75.4	0.117	15	7	17	7	26	11	36	17	46	23	51	27	50	27	43	24	36	20	0.30	6

[a] Includes outside surface resistance, ⅜" slag, membrane and ⅜" felt on the top (code number A4 of Table 41) and inside surface resistance on the bottom (code number E0 of Table 41). The property data for components are listed in Table 41.
[b] Dark roof, $a/h_o = 0.30$; light roof, $a/h_o = 0.15$.
[c] Nominal thickness of wood.

Explanation: {Total heat transmission from solar radiation and temperature difference between outdoor and room air. Btu per (hr) (sq ft) of roof area} = {Equivalent Temperature Differential from above table} × {Heat transmission coefficient for summer, Btu per (hr) (sq ft) (F deg)}

1. *Application.* These values may be used for all normal air conditioning estimated; usually without correction (except as noted below) in latitude 0 deg to 50 deg north or south when the load is calculated for the hottest weather.

2. *Corrections.* The values in the table were calculated for an inside temperature of 75 F and an outdoor maximum temperature of 95 F with an outdoor daily range of 21 F deg. The table remains approximately correct for other outdoor maximums (93–102 F) and other outdoor daily ranges (16–34 F deg) provided the outdoor daily average temperature remains approximately 85 F. If the room air temperature is different from 75 F and/or the outdoor daily average temperature is different from 85 F, Equation 43 can be used for computing new values or the following rules can be applied:
   a. For room air temperature less than 75 F, add the difference between 75 F and room air temperature; if greater than 75 F, subtract the difference.
   b. For outdoor daily average temperature less than 85 F, subtract the difference between 85 F and the daily average temperature; if greater than 85 F, add the difference.

3. *Attics or other spaces between the roof and ceiling.* If the ceiling is insulated and a fan is used for positive ventilation in the space between the ceiling and roof, the total temperature differential for calculating the room load may be decreased by 25 percent.

From Handbook of Fundamentals, 1972, American Society of Heating, Refrigeration and Air Conditioning Engineers.

NOTE: Standard residential roof construction is in the first light group. The line titled '2" insulation + 1" wood' is to be used. The designations "D" and "L" are to mean dark and light per the definitions of this resolution. (See Definition F.)

Description of Wall Constructions*

Group	Components	Wt, lb per sq ft	U Value
A	1" stucco+4" l.w. concrete block+air space	28.6	0.28
	1" stucco+air space+2" insulation	16.3	0.10
B	1" stucco+4" common brick	53.9	0.39
	1" stucco+4" h.w. concrete	62.5	0.48
C	4" face brick+4" l.w. concrete block+1" insulation	62.5	0.15
	1" stucco+4" h.w. concrete+2" insulation	62.9	0.11
D	1" stucco+8" l.w. concrete block+1" insulation	41.4	0.14
	1" stucco+2" insulation+4" h.w. concrete block	38.6	0.11
E	4" face brick+4" l.w. concrete block	62.2	0.33
	1" stucco+8" h.w. concrete block	56.6	0.34
F	4" face brick+4" common brick	89.5	0.38
	4" face brick+2" insulation+4" l.w. concrete block	62.5	0.10
G	1" stucco+8" clay tile+1" insulation	62.3	0.141
	1" stucco+2" insulation+4" common brick	58.2	0.10
H	4" face brick+8" clay tile+1" insulation	96.4	0.13
	4" face brick+8" common brick	129.6	0.23
	1" stucco+12" h.w. concrete	153.9	0.38
	4" face brick+2" insulation+4" common brick	89.5	0.10
	4" face brick+2" insulation+4" h.w. concrete	96.5	0.11
	4" face brick+2" insulation+8" h.w. concrete block	90.6	0.10
I	1" stucco+8" clay tile+air space	62.6	0.20
	4" face brick+air space+4" h.w. concrete block	69.9	0.28
J	face brick+8" common brick+1" insulation	129.3	0.14
	4" face brick+2" insulation+8" clay tile	96.5	0.094
	1" stucco+2" insulation+8" common brick	98.3	0.100
K	4" face brick+air space+8" clay tile	96.2	0.200
	4" face brick+2" insulation+8" common brick	129.9	0.098
	4" face brick+2" insulation+8" h.w. concrete	143.3	0.107
L	4" face brick+8" clay tile+air space	96.2	0.200
	4" face brick+air space+4" common brick	89.5	0.255
	4" face brick+air space+4" h.w. concrete	96.2	0.301
	4" face brick+air space+8" h.w. concrete block	90.2	0.246
	1" stucco+2" insulation+12" h.w. concrete	155.3	0.106
M	4" face brick+air space+8" common brick	129.6	0.218
	4" face brick+air space+12" h.w. concrete	180.5	0.23
	4" face brick+2" insulation+12" h.w. concrete	180.9	0.104

* In addition to the structure components listed above, all walls had an outside surface resistance (code number AO of table 41) and on the inside: a ¾ in. layer of plaster, gypsum or other similar finishing material and an inside surface resistance (code numbers E1 and E0 respectively of Table 41).

North Latitude Wall Facing	Sun Time A.M. 8 D	8 L	10 D	10 L	12 D	12 L	P.M. 2 D	2 L	4 D	4 L	6 D	6 L	8 D	8 L	10 D	10 L	12 D	12 L	Amplitude Decrement Factor, λ	Time Lag, δ hr	South Latitude Wall Facing
Group A*																					
NE	27	16	31	18	28	17	24	17	24	18	23	17	20	15	17	13	15	11	0.34	2	SE
E	32	18	41	24	37	22	29	20	28	20	26	19	23	16	20	14	18	13			E
SE	25	15	36	21	33	23	33	21	28	20	26	18	22	16	19	14	18	12			NE
S	14	9	20	13	28	18	33	22	31	21	25	18	20	15	17	13	15	11			N
SW	17	11	20	13	24	16	34	22	42	27	41	28	28	19	20	14	18	12			NW
W	17	11	20	13	24	16	30	20	42	27	48	30	33	22	22	15	10	13			W
NW	14	9	17	11	21	14	23	17	31	21	38	25	28	19	18	13	16	11			SW
N	14	9	15	10	17	12	20	18	21	16	21	16	18	14	14	11	12	9			S
Group B*																					
NE	12	7	27	14	31	17	30	19	31	21	30	22	27	20	21	17	16	13	0.51	3	SE
E	14	8	34	18	45	24	43	25	39	25	35	24	30	22	23	18	17	14			E
SE	9	5	25	13	39	21	44	26	41	26	37	25	31	23	24	18	17	14			NE
S	4	3	7	4	13	11	32	19	41	26	39	27	33	24	25	19	18	15			N
SW	3	3	7	4	11	7	23	15	41	26	54	34	51	33	38	25	26	19			NW
W	5	4	7	4	11	7	18	12	35	23	53	34	59	37	43	23	30	20			W
NW	3	3	6	4	11	7	17	12	26	18	41	27	47	31	36	24	25	18			SW
N	6	4	9	5	12	8	18	12	22	17	25	20	27	21	22	17	16	14			S
Group C*																					
NE	9	6	19	10	26	15	28	17	29	18	29	20	28	20	24	19	20	16	0.40	4	SE
E	10	7	22	12	36	19	40	23	39	23	36	24	33	23	26	20	22	17			E
SE	8	6	16	9	29	16	38	21	39	24	37	24	34	23	28	21	23	17			NE
S	7	5	7	4	12	7	22	14	32	20	36	24	34	24	29	21	23	17			N
SW	9	6	8	5	10	6	16	10	23	18	42	26	43	30	42	28	33	22			NW
W	10	7	9	5	10	6	14	9	24	16	40	25	52	32	47	30	37	24			W
NW	8	6	8	5	9	6	13	9	19	14	30	20	40	27	38	26	30	21			SW

Exterior color of wall—D = dark, L = light

TABLE 3 (Continued)

Total Equivalent Temperature Differentials for Calculating Heat Gain Through Sunlit Walls (Continued)

North Latitude Wall Facing	Sun Time A.M. 8 D	8 L	10 D	10 L	12 D	12 L	P.M. 2 D	2 L	4 D	4 L	6 D	6 L	8 D	8 L	10 D	10 L	12 D	12 L	Amplitude Decrement Factor, λ	Time-Lag, δ hr	South Latitude Wall Facing
	Exterior color of wall—D = dark, L = light																				
Group D[a]																					
NE	8	5	19	10	28	15	29	17	30	19	30	21	28	21	24	19	19	16			SE
E	9	6	23	12	38	20	42	24	40	24	37	24	33	23	27	20	21	17			E
SE	7	3	16	9	30	16	40	22	41	25	38	25	34	24	28	21	22	17			NE
S	5	4	6	4	12	7	23	14	34	21	38	25	35	24	29	21	23	17			N
SW	8	5	7	4	9	6	16	10	30	19	44	28	51	32	43	28	33	22	0.45	4	NW
W	8	6	7	3	9	6	14	9	25	16	42	27	55	34	49	31	37	25			W
NW	7	5	7	4	9	6	13	9	20	14	31	21	42	28	40	27	31	21			SW
N	6	4	8	5	10	6	14	10	19	14	23	17	25	19	24	19	19	16			S
Group E[a]																					
NE	10	6	23	12	30	16	30	18	30	20	30	21	28	21	23	18	18	14			SE
E	11	6	23	13	42	22	43	24	39	24	36	24	32	23	25	19	19	15			E
SE	8	5	20	11	35	19	42	24	41	25	38	25	33	23	26	20	20	16			NE
S	4	3	6	4	15	9	28	17	38	24	39	26	34	24	27	20	20	18			N
SW	6	4	7	4	10	6	19	12	35	22	49	31	52	33	41	27	30	21	0.48	4	NW
W	7	5	7	4	10	6	16	11	30	20	48	31	57	36	47	30	34	23			W
NW	6	4	6	4	10	6	15	10	23	16	36	24	45	30	33	26	28	20			SW
N	6	4	8	5	11	7	16	11	21	15	24	18	26	20	23	18	18	15			S
Group F[a]																					
NE	9	7	14	9	21	12	23	15	27	17	29	19	28	20	26	19	23	17			SE
E	10	8	17	10	28	15	35	19	37	22	37	23	35	23	31	22	26	19			E
SE	10	7	13	8	22	12	31	17	36	21	37	23	35	23	32	22	27	19			NE
S	9	7	7	5	10	6	17	10	26	16	32	20	33	22	31	22	27	19			N
SW	12	9	10	6	9	6	13	8	22	14	33	21	42	27	42	27	37	25	0.32	6	NW
W	14	9	11	7	10	6	12	8	19	12	31	20	43	27	46	29	41	27			W
NW	12	8	9	6	9	6	11	8	16	11	24	16	33	22	36	24	33	23			SW
N	8	7	8	6	9	6	12	8	13	11	19	14	22	17	23	18	21	17			S
Group G[a]																					
NE	11	9	10	15	20	12	24	14	25	16	26	17	27	18	26	18	23	17			SE
E	13	9	17	11	26	15	32	18	34	20	34	21	33	22	31	21	27	19			E
SE	13	9	14	9	21	12	28	16	33	19	34	21	33	22	31	21	27	19			NE
S	12	9	10	7	11	8	16	10	23	13	29	18	30	20	29	20	26	19			N
SW	16	11	13	9	13	8	14	9	20	13	29	19	37	24	39	25	35	23	0.25	6	NW
W	18	12	13	10	14	9	14	9	18	12	27	18	38	24	42	26	38	25			W
NW	14	10	12	8	12	8	13	9	16	11	21	15	29	20	33	22	31	21			SW
N	10	8	10	7	10	7	12	8	15	10	18	13	20	15	21	16	20	16			S
Group H[a]																					
NE	13	11	16	11	18	12	20	13	22	14	24	15	25	16	25	17	24	17			SE
E	18	13	18	12	22	14	26	16	29	17	30	19	31	20	30	20	29	19			E
SE	18	13	17	12	19	12	23	14	27	16	29	18	30	19	30	20	28	19			NE
S	16	12	14	10	14	10	15	10	19	12	23	15	25	17	26	18	26	18			N
SW	22	14	19	12	17	11	16	11	18	12	23	15	29	18	32	21	32	21	0.14	8	NW
W	23	15	20	13	18	12	17	11	18	12	22	15	29	18	33	21	34	22			W
NW	19	13	17	11	15	10	15	10	15	11	18	12	23	15	26	18	27	19			SW
N	13	10	12	9	11	9	12	9	13	10	15	11	17	13	18	14	19	14			S
Group I[a]																					
NE	16	11	18	12	20	13	22	14	23	15	24	16	24	16	23	16	22	16			SE
E	19	13	21	14	25	16	29	17	30	18	30	19	29	19	28	19	26	18			E
SE	19	13	19	13	22	14	26	16	28	18	29	18	29	19	28	18	26	18			NE
S	16	12	15	11	16	11	18	12	21	14	24	16	25	17	25	17	23	16			N
SW	20	14	19	13	18	12	19	13	22	14	27	17	31	20	32	20	30	20	0.13	6	NW
W	22	14	20	13	19	13	20	13	22	14	26	17	31	20	33	21	32	21			W
NW	18	12	16	11	16	11	17	11	18	12	21	14	25	17	27	18	28	18			SW
N	13	10	12	9	13	9	13	10	15	11	16	12	18	13	18	14	18	14			S

Total Equivalent Temperature Differentials for Calculating Heat Gain Through Sunlit Walls (Concluded)

North Latitude Wall Facing	Sun Time A.M. 8 D	8 L	10 D	10 L	12 D	12 L	P.M. 2 D	2 L	4 D	4 L	6 D	6 L	8 D	8 L	10 D	10 L	12 D	12 L	Amplitude Decrement Factor, λ	Time Lag, δ hr	South Latitude Wall Facing
	Exterior color of wall—D = dark, L = light																				
Group J[a]																					
NE	18	13	17	12	18	12	19	13	21	13	22	14	23	15	23	16	23	16	0.10	9	SE
E	22	15	20	14	21	14	24	15	26	16	28	17	29	18	29	19	29	19			E
SE	21	15	20	14	20	13	21	14	24	15	26	16	28	17	28	18	28	18			NE
S	19	14	17	12	16	11	16	11	17	12	20	13	22	15	24	16	24	16			N
SW	24	16	22	15	20	13	19	13	19	13	21	14	24	16	28	18	30	19			NW
W	26	17	24	16	22	14	20	13	20	13	21	14	24	16	23	18	31	20			W
NW	21	15	19	13	18	12	17	11	17	11	17	12	19	13	22	15	25	17			SW
N	15	11	14	11	13	10	13	9	13	10	14	10	15	11	17	12	17	13			S
Group K[a]																					
NE	19	14	19	13	19	13	20	13	20	14	21	14	22	15	22	15	22	15	0.08	11	SE
E	23	16	22	15	23	15	24	16	26	16	27	17	27	17	28	18	27	18			E
SE	23	15	22	15	22	14	22	15	24	15	25	16	26	17	27	17	27	17			NE
S	20	14	19	13	18	12	18	12	18	13	20	13	21	14	22	15	23	15			N
SW	25	16	23	15	22	14	21	14	21	14	22	15	24	16	26	17	27	18			NW
W	26	17	24	16	23	15	22	15	22	14	23	15	24	16	27	17	28	18			W
NW	21	15	20	14	19	13	18	13	18	12	19	13	20	14	22	15	23	16			SW
N	15	11	14	11	14	10	14	10	14	10	14	11	15	11	16	12	16	12			S
Group L[a]																					
NE	18	13	18	13	19	13	20	13	21	14	22	15	23	15	23	16	22	15	0.08	8	SE
E	22	15	22	14	23	15	25	16	27	17	28	18	28	18	28	18	27	18			E
SE	21	14	21	14	22	14	23	15	25	16	27	17	27	17	27	18	26	18			NE
S	19	13	17	12	17	12	18	12	19	13	21	14	23	15	23	16	23	16			N
SW	23	15	22	14	21	14	20	13	21	14	23	15	26	17	28	18	28	18			NW
W	25	16	23	15	22	14	21	14	22	14	24	15	26	17	29	19	30	19			W
NW	20	14	19	13	18	12	18	12	18	12	19	13	21	15	23	16	24	16			SW
N	14	11	14	10	13	10	13	10	14	10	15	11	16	12	17	13	17	13			S
Group M[a]																					
NE	20	14	20	14	19	13	20	13	20	14	20	14	21	14	21	14	22	15	0.05	12	SE
E	25	16	24	16	24	16	24	16	26	16	23	16	26	17	27	17	27	17			E
SE	24	16	23	15	23	15	23	15	23	15	24	16	25	16	25	16	26	17			NE
S	21	14	20	14	19	13	19	13	19	13	19	13	20	14	21	14	21	15			N
SW	25	17	25	16	24	16	23	15	22	15	22	15	23	15	24	16	25	17			NW
W	27	17	26	17	25	16	24	16	23	15	23	15	24	15	25	16	26	17			W
NW	22	15	21	14	20	14	20	13	19	13	19	13	19	13	20	14	21	15			SW
N	15	12	15	11	14	11	14	11	14	11	14	11	15	11	15	11	16	12			S

[a]See "Description of Wall Construction" table above for details of each wall grouping.

Explanation: (Total heat transmission from solar radiation and temperature difference between outside and room air, Btu per (hr) (sq ft wall area)) = (Equivalent temperature differential from above table) × (Heat transmission coefficient for wall, Btu per (hr) (sq ft) (F deg))

1. *Application:* These values may be used for all normal air-conditioning estimates; usually without correction (except as noted below) when the load is calculated for the hottest weather.

2. *Corrections:* The values in the table were calculated for an inside temperature of 75 F and an outdoor maximum temperature of 95 F with an outdoor daily range of 21 F deg. The table remains approximately correct for other outdoor maximums (93–102 F) and other outdoor daily ranges (16–34 F deg) provided the outdoor daily average temperature remains approximately 85 F. If the room temperature is different from 75 F and/or the outdoor daily average temperature is different from 85 F. Equation 43 can be used for computing new values or the following rules can be applied:

a. For room air temperature less than 75 F, add the difference between 75 F and room air temperature; if greater than 75 F, subtract the difference.

b. For outdoor daily average temperature less than 85 F, subtract the difference between 85 F and the daily average temperature; if greater than 85 F, add the difference.

The table values will be approximately correct for the east or west wall in any latitude (0 deg to 50 deg North or South) during the hottest weather. Equation 43 should be used for obtaining values for the north or south wall in latitudes other than 40 deg.

3. *Color of exterior surface of wall:* Use temperature differentials for light walls only when the permanence of the light wall is established by experience. For cream colors use the values for light walls. For medium colors interpolate half way between the dark and light values. Medium colors are medium blue, medium green, bright red, light brown, unpainted wood, natural color concrete, etc. Dark blue, red, brown, green, etc., are considered dark colors.

From Handbook of Fundamentals. 1972, American Society of Heating, Refrigeration and Air Conditioning Engineers

Chapter 5. Obstacles to Energy Conserving Lifestyle Changes

The adoption of energy conserving behavioral changes or low-energy lifestyles by a larger segment of the population faces a variety of obstacles, both individual and societal (institutional). We comment briefly on some of the obstacles and possibilities for reducing their effect. Items related to actions which do not require significant life-style changes as well as those related to the experiments described in previous chapters are discussed.

Under the heading of individual constraints we consider perceptions of the energy problem, personal commitments, goals and values, and preparation for different lifestyles. Institutional constraints include laws and regulations, financing practices, economic factors and environmental factors. Social implications of increased home labor, especially its compatibility with the rising career aspirations of women, are also discussed.

5.1 Public Attitudes Toward Energy Conservation

A recent study (Drossler Research Corporation, 1976) showed that the California consumer was reasonably well informed about the energy situation but generally not convinced that a serious problem exists. The study also found the consumer to be knowledgeable about some of the behavioral changes that would lead to reduced energy consumption but concluded that "...behavioral changes could be stimulated on a meaningful level only when shortages reach crisis proportions..." (p. 1). A further conclusion was that to sustain behavioral change would be quite difficult and would require very expensive and frequent reminders. These rather pessimistic observations about the possibility for behavioral change are generally confirmed by other surveys (Blakely; Thompson and Mctavish). However, on a more positive note, the latter study found that when people did believe there was a present or a longer term energy problem, they took correspondingly greater conservation actions than those people who did not.

A more optimistic view is provided by a recent newspaper column based on an interview with three public opinion experts in California during the height of the natural gas shortage and frigid weather in the midwest and eastern parts of the United States (Sacramento Bee, February 3, 1974, p. A-1). The writer suggests that the energy shortage of the winter of 1976-77 may have marked a turning point in our history and in the way Americans view life. One of the public opinion experts, Mervin Field, commented that recent shocks (natural gas and water shortages) have caused Californians to realize that life will be much different in the future and believes that they are ready to accept a "grimmer" future. However, each of the pollsters warned that there are many "cross currents" in public opinion and that people are going to be skeptical. "People will accept sacrifices on one condition--as long as they are fairly administered. People don't mind sacrifices if they are across the board." Equitability is undoubtedly important, but an essential prerequisite is that people believe that a problem is serious enough to require sacrifices.

With the approach of spring, the concerns about natural gas shortages that existed two months ago seem to have largely disappeared. The extent of lasting change brought about by those "crisis" conditions remain to be evaluated. However, a look at the consumption of automobiles in the United States in recent months gives cause for pessimism. An April 1st article (Sacramento Bee, page C-3) notes that "...three out of four new car buyers are choosing big, 'gas guzzling' V-8 engines to power their trimmer models," a clear indication that the American public has forgotten the fuel shortages and long lines at gasoline stations of late 1973 and early 1974. At that time (1974 model year) sales of 4 cylinder engines reached a record 12.7%, whereas at present they are only 5.7%. Clearly small cars and small engines have lost favor with the public. The pessimistic view is supported by a recent Roper Organization poll, which found that the public was strongly in favor of developing new energy sources and just as strongly opposed to conservation measures. About three-fourths of the respondents opposed any moves that would lead to higher prices for oil and gas (Wall Street Journal, April 21, 1977, p. 27).

Even when a person believes there is a problem and that it is desirable for someone to take action, the question is what action and how much are individuals willing to sacrifice. The most appealing response is to develop a technological solution which requires no sacrifices at all. The Drossler survey found that 73 percent of the respondents believe that technology will solve the energy problem (Drossler Research Corp.). Faith in technology, an outstanding national characteristic, can be counterproductive by preventing individuals from taking the responsibility for making behavioral changes that can lead to important energy savings.

The responses of several prominent public figures to President Carter's energy policy message to Congress alluded to this technological optimism and other aspects of the American character. Senator Howard Baker and Republican National Committee Chairman William Brock commented, in a post-speech interview (CBS Television, April 20), that this approach--i.e., conservation--just isn't the American way; that we've always solved our problems by producing more and that's what we should do now. Representative

Robert Bauman (R-Md.) was quoted as saying, "...asking America, the richest nation on earth, to start acting like a poor nation is contrary to the character of our people." (Davis Enterprise (UPI) April 21, 1977, p. 14). If these comments reflect an accurate perception of the attitudes of a majority of Americans, then the adoption of attitudes compatible with more frugal living is a long way off. As the Drossler study noted, it will take sustained crisis conditions, not merely the President and other experts telling the public that a crisis is impending, to change attitudes and behavior significantly.

5.2 Lifestyle Changes

Major changes in lifestyle are difficult to make and it would be unrealistic to expect very many people who are presently employed in mainstream jobs to pull up stakes and join the back-to-the-land movement. It would, of course, be much easier to move to nearby new towns or energy conserving communities of the kind described in previous chapters since these are much closer to existing lifestyles. Even though many people may be unhappy with their present jobs and conditions of their lives, perceived financial responsibilities and other commitments to family, friends, and associates at work make it very difficult for most people to envision the possibilities for a major change. The success of alternative lifestyle publications, national media treatment, and surveys (Elgin and Mitchell, 1976) indicate that there is considerable sympathy for the movement and at least a vague desire among many people to participate in it. And, those who have joined the movement and publicized it so favorably have been an important influence on others who might consider such a move. The stories of success, despite inevitable obstacles, show that changing one's lifestyle is possible and, no doubt, inspires others to make the change. However, the romantic treatment of the back-to-the-land movement may be a disservice to some who have made (or will make) the change without adequate preparation. Certainly, the difficulties that can be encountered by inexperienced former urbanites, especially those attempting a self-sufficient homestead, can be very great. Those persons who find true self-sufficiency appealing should be aware of the hazards of isolation, boredom, long hours of very hard work, and the unpredictable forces of nature. Stewart Brand's comment on self-sufficiency, quoted earlier, (Sec. 2.2) should be read carefully.

5.3 Obstacles to Innovation

There are a variety of obstacles to innovation which may affect the prospects for success of an energy conserving community such as Village Homes or a new town such as Cerro Gordo. The major obstacles faced by subdivisions of the Village Homes type are the reluctance of financial institutions to lend money for innovative projects and the conservative nature of building codes and the planning and permit approval process in local jurisdictions.

The Village Homes project almost failed before it began for lack of a lender to finance the initial site preparation--grading, drainage, and streets. The banks were frankly unwilling to go along with such innovative design which included narrow streets, large south facing windows, drainage ponds, a farm within the subdivision, and collective ownership of property by a homeowners association. In addition, the Federal Housing Administration (FHA) initially refused to approve the project for FHA home mortgage loans. Without FHA approval banks were unlikely to invest in the subdivision.

FHA objections were similar to the banks' and the agency commented that Village Homes deviated from accepted development practices to the extent that future marketability may be impaired (Deprato and Corbett, 1977). Fortunately, the Davis Planning Director, Gloria McGregor, intervened with FHA and was able to influence the agency to give Corbett a further hearing at which time approval was obtained. The FHA, however, required two conditions: no farm animals, and no homeowner association ownership of apartments in the first phase. Even with FHA approval, Corbett needed the help of his stepfather, a successful developer in the Sacramento area, to obtain the construction loan. Moreover, he had to agree that solar heating would be optional, not required, no farm animals would be kept, no homeowners association-owned investment properties would exist in the first phase, and that carports would be widened to accommodate American cars. After these concessions to conventional design, it was still necessary for Corbett's step-father to act as a co-signer of the construction loan and to agree to build ten of his traditional houses in the first phase of the subdivision.

The integration of farms or orchards within suburban subdivisions could present legal problems and leave the innovative developer on shaky ground. This does not appear to be the case in Davis, where the approval of the farm under planned development (PD) zoning granted specific legal rights to conduct the agricultural enterprise (Owen, 1977). However, it is possible that in other jurisdictions the use of planned unit development zoning may not afford the same legal rights to conduct a farm operation within a subdivision. This depends on the wording of the local PUD zoning ordinance. If the legal right to farm is shaky, the farm operation could be terminated more easily and arbitrarily, especially in response to complaints from nearby residents about the disamenities of farm operations.

Since the Village Homes farm will be operated by salaried workers, only some of whom will be Village residents, the farm may be viewed by the homeowners as another profit-making enterprise, (such as the Village stores or apartments), and not as an essential part of a more self-sufficient lifestyle. Residents have already expressed concern over the extent of their liability if a business operated by the homeowners association should fail. They are worried, quite understandably, that their liability might extend beyond their investment in the homeowners association to their personal property.

In a situation where technology is new, e.g. solar heating, several potential problems could emerge. Inexperienced developers or promoters of new equipment for solar installations may enter the industry since the field is wide open and few established developers have accepted the new technology. In such a rapidly growing new field, we can expect some of the products to be of low quality, either as a result of incompetence or dishonesty. Because widely accepted standards do not exist (at least officially), the prospective home buyer will be on his own to determine the reliability of the builder. Questions of liability will undoubtedly emerge and it is possible that local jurisdictions, which issue building permits, may wind up as defendants in court suits for damages from disgruntled homeowners. Excessive local government concern about damage suits could deter innovation.

Additional legal and social complications in the design of innovative communities such as Village Homes or new towns such as Cerro Gordo lie in the joint ownership of property by homeowners. Since it is generally necessary for the original group of homeowners to sell shares to new homeowners as they buy into the development or because the homeowners share in commercial ventures such as at Village Homes, it would appear necessary for the association or corporation to register with the Securities and Exchange Commission. This may only be a minor inconvenience. However, in situations where people do not have adequate legal advice, both the legal and interpersonal problems of communal ownership of property can be serious.*

Building Codes

Alternative lifestyle persons have generally not built houses in conformity with the uniform building code because it is too expensive to do so (most of the houses in our survey were built for less than 20% of what a minimum conforming house would cost). Thus, alternative lifestyle persons face the danger of eviction from their homes if building codes are enforced, unless an accommodation has been reached with local government. In California, the State Housing and Community Development Commission did act to encourage local governments to accept alternative lifestyle (Class K) housing in rural areas but did not mandate them to do so (*Sacramento Bee*, July 24, 1976; p. A-3).

Building codes can also inhibit innovation in solar and other building technology which may critically affect a new community project such as Village Homes. Most building codes do not specify performance requirements but do specify which materials, components and subsystems are approved for construction. Therefore, each new technology must prove that it is equal to the products that have already been approved under the code. Consequently the code favors existing products and techniques over new competitors. If

* Some of the problems of property ownership faced by communes are described in Kanter (1973).

modification of the code is required before innovation can be tried, it will be a rare contractor who will specify such an item (Schoen, et al., p. 97).

5.4 Constraints to Alternative Lifestyles

For those who have overcome doubts about trying the rural alternative many problems still remain. If financial resources are meager, which seems to be generally the case, the purchase of suitable land is the first major obstacle. The primary requirements are low cost; accessibility by road but, for many, not too accessible; a supply of water; some land suitable for farming or gardening and a supply of wood. Moderate slope is also important for farming and home building. It is virtually impossible to meet all of these requirements, primarily because there is no longer any good farm land in the state that is cheap. Even relatively low quality farmland of moderate slope and adequate water is likely to cost at least $1,000 an acre and probably more. If the land has already been subdivided into 5 or 10 acre parcels, the cost per acre is likely to be much higher. Most of the homesteads that we saw in the foothills were 20 acres or larger and the land costs there were much lower than $1,000 per acre. However, most of that land is of low quality and unsuitable for farming unless great efforts are made to improve its quality by the addition of large amounts of organic matter. We have not tried to determine what the potential supply of homestead land is but my guess is that suitable land for small scale homesteading is not easy to find. There is no doubt that continued growth in the back-to-the-land movement will raise the price of small parcels substantially, and very likely place them beyond the reach of many prospective buyers (in California). If land is suitable for farming, rapidly increasing agricultural commodity prices (e.g., grains, soybeans) are likely to drive land prices to excessive levels for small scale homesteading.

Even if there is enough money to buy land and begin the homesteading venture other economic obstacles may prove to be serious in the future. As already noted in Section 3.5, jobs are scarce, prospects for wage income are generally poor and entrepreneurial activities are frequently unsuccessful. They too depend on the larger economy for sales as there may not be enough money in alternative lifestyle communities to support craftsmen and other entrepreneurs.

5.5 Social Implications of Increased Home Labor

Changes in behavior toward greater frugality generally require larger amounts of labor or giving up goods or activities which previously provided enjoyment or satisfaction. If the individual finds the additional labor satisfying (e.g., by providing feelings of increased competence or contributing to solving a societal problem), the change can leave the individual feeling that he/she has gained something rather than sacrificed. So too, if an individual changes consumption and activity patterns to reduce energy use, it is possible to feel better off if a change in values accompanies the change in behavior. Incentives, such as taxes or subsidies, could promote voluntary changes by altering the individual's personal benefit calculation. Without such a value change or incentives, voluntary changes in behavior cannot be expected as they would leave the individual feeling worse off.

When energy conserving lifestyle changes are considered in the context of a mainstream lifestyle, a potentially important issue related to the substitution of labor for energy concerns the job status of women. The increasing career expectations of many women are generally not compatible with increased amounts of home labor, especially in households where women must do a major share of the housework. In the rural alternative lifestyle the issue is one of role rather than career or job aspirations, since few alternative lifestyle people think in terms of "career." However, the alternative lifestyle requires large amounts of labor, which could (depending on the persons involved) relegate women to traditional roles of mother and housekeeper while leaving men free to pursue more varied and creative activities, including travel. The demands of a homestead can be highly restrictive, especially for women who accept the traditional role.

In mainstream society it appears that work patterns create a major obstacle to the achievement of greater home production activity. Many people, especially professionals, are overemployed--they work very long hours and are often under considerable stress. Their leisure time is most likely to be spent on activities which involve high levels of consumption as these confer the greatest utility or economic value.* Such individuals are likely to buy an appliance or hire someone to perform a household task rather than spend their own time because such activities are often not economical when evaluated in terms of the dollar value of the individual's time. It is possible that changes in the length of the work day and the way in which work is organized could contribute to an increase in home production activities and their being valued more highly by larger numbers of people. Certainly, the sharing of jobs would provide more free time for home activities. If these activities have real economic value,

* An excellent analysis of leisure behavior and the myth of increasing leisure time, from an economist's point of view, is found in Linder, The Harried Leisure Class (1970).

such as the growing and preserving of food, the production of furniture, and the maintenance of home and automobile, then some loss of salary from a shorter work week would be compensated by the value of home production. More job sharing would, of course, provide opportunities for large numbers of women, who are now reluctant to work full time and cannot obtain parttime jobs, and thereby contribute to the total income of many households. While we do not expect many persons to voluntarily accept lower incomes, the increasing trend toward "simple living" observed by Elgin and Mitchell (1976) would indicate that a substantial number of persons might voluntarily reduce their work commitments and their salaries. Such a choice would be even more appealing if other household members are likely to obtain parttime jobs as a result of the voluntary reduction by others. A major obstacle to the wider adoption of work sharing would appear to be organizations, not individuals. Many organizations will no doubt find it difficult to envision high level employees working parttime. We cannot say for sure whether two employees sharing a job will be more productive than one, but that possibility seems as likely as not. The experiment is worth trying on a large scale, especially in job categories where there is an oversupply of labor.

Although job sharing could revise the economic calculation of individuals with regard to home activities, it is not likely to change the psychological value that individuals place on such activities. The fault for low value being placed on doing things ourselves can be traced to societal values and the way we are educated and socialized. For most people, buying something has greater status than making it; owning something new and expensive is best of all. A primary facet of our education is as consumers--we are taught to satisfy needs and desires by consuming rather than by creative and productive, or even contemplative, activities (Goodman, Theobold). This reflects the high value that we place on acquiring money and goods rather than on such things as competence (in doing things ourselves) and self-reliance, and other non-material values.

Although energy conserving actions within the framework of existing behavior and values are possible, for example, by redesign of buildings or communities, the adoption of a frugal lifestyle requires different attitudes about consumption and about what things are important in life. Certainly, conservation actions which do not require major value changes will be easier to achieve but their benefits will fall far short of what is possible with the adoption of frugal lifestyles.

Chapter 6. Concluding Comments

We have avoided estimating the present or potential energy savings from the energy conserving lifestyles discussed in previous sections. Certainly, the present saving is very small when measured in terms of total U.S. energy consumption because the number of experimenters is relatively small. Furthermore, it is unlikely that within the foreseeable future (say 20 years), there will be enough persons living the types of lower energy lifestyles described here to have a large impact on total energy consumption. However, we believe that the importance of the experimenters with new ways of living exceeds their relative numbers. They are not only showing the way to new lifestyle possibilities and thereby broadening the options for all of us, which we believe is socially desirable, but are embracing values and behaviors that are compatible with emerging resource limitations. Furthermore, they are demonstrating that more frugal living is not only possible but can be satisfying.

The case for reducing our rate of growth of energy use has been made in several widely read works* and seems incontrovertible to me. However, most studies (Lovins' excepted) have, heretofore, shied away from recommending conservation measures that require significant lifestyle changes, and asked instead, "What can we achieve without making lifestyle changes?" Now that President Carter has taken the initiative to tell the American people that the energy situation requires lifestyle changes, perhaps we will start considering and experimenting with more substantial changes.

Many possibilities exist, from the radical lifestyle change of the rural homestead, without electricity or most appliances, to the modest changes found in energy conserving subdivisions and new towns. But such

* See Freeman (1974), Energy Policy Project (1974), Lovins (1976).

alternatives will require time to produce substantial reductions in the rate of growth of national energy use. The greatest reduction in energy use, by far, will have to come from the adoption of lifestyle changes by persons who continue to work at the same jobs and live in the same neighborhoods as at present. The recognition of this prospect should not be raised as a barrier to change. On the contrary, it is important to consider incentives to hasten the adoption of lifestyle changes both by encouraging the growth of a variety of new alternatives as well as by promoting desired changes within more traditional situations. Most of the many possible changes in patterns of consumption and activities, which have been discussed in previous sections in the context of the three lower energy alternatives, can be used in or adapted to traditional situations.

We cannot predict the consequences of such changes very well. Adopting more frugal lifestyles need not mean that individuals will be worse off than now, if the change in behavior is accompanied by changes in values from those which govern much of our present behavior. To many this will seem like giving up the American dream of increasing affluence and material consumption--a difficult thing to do.

The likelihood that there will be negative economic consequences to some sectors of the economy, and that some individuals will suffer thereby, should not be neglected. Those who lose jobs will be forced to adopt a lifestyle of inelegant frugality in contrast to the "elegant frugality" that Lovins (1976) foresees as possible (for those who retain their means of livelihood). We must accord high priority to preventing or reducing these negative effects of lifestyle changes. However, it should be recognized that the alternate path of continued profligacy is not without risk.

Indeed, it appears to be the riskier of the two. It, therefore, seems prudent to start making lifestyle changes now rather than having them forced suddenly upon us, with potentially dire consequences, when resource limitations and rapidly increasing prices finally confront us.

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