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PUBLIC OPINION CONCERNING GEOTHERMAL DEVELOPMENT IN LAKE COUNTY, CALIFORNIA

Larry Vollintine and Oleh Weres
Energy and Environment Division
March 1976

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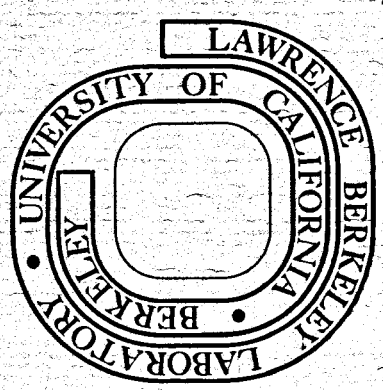

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Abstract

In the spring of 1975 a group of students from the University of California, Berkeley, polled a random sample of 2500 of the registered voters of Lake County, California, about their opinions regarding the prospect of the development of geothermal energy in Lake County. The results of a secondary analysis of their responses are presented herein.

Our main conclusions are:

1) A large majority of the respondents are in favor of geothermal development provided that it is suitably regulated to minimize negative environmental impacts.

2) The main determinants of the respondents' approval or disapproval of geothermal development are their expectations concerning the environmental impacts of geothermal development and the economic benefits of development for the county. Essentially all respondents who do not perceive negative environmental impacts support development, and the expectation of increased job opportunities and/or tax revenues is a nearly absolute prerequisite for support of development.

3) Pro- and anti-geothermal bias have strong effects upon the formation of opinions about leasing and the perception of environmental impacts.

4) Purely demographic characteristics of the respondents, such as employment status and years of residence in the county, have only limited effects upon their attitudes toward geothermal development except in the southern portion of the county, where longer term residents and those who live in the county for reasons of employment are more in favor of development.

I. Introduction

The developed portion of the Geysers geothermal field is located in the extreme northwest corner of Sonoma County, California, an area whose economy before the advent of geothermal energy consisted of grazing, deer hunting, several mercury mines, and an old hot springs resort. Its present population is less than fifty, and the nearest communities within Sonoma County are fifteen miles away.

However, the field is now being expanded into Lake County, about a thousand of whose residents live within four miles of it in a string of retirement and resort communities. There have already been numerous complaints about hydrogen sulfide odor and the noise of air-drilling from the people in these communities. There are already some twenty proven wells in Lake County and, indeed, it appears that the bulk of the reservoir lies in this county rather than Sonoma. If the whole of the Lake County portion of the Geysers-Calistoga KGRA (Known Geothermal Resource Area) is developed, at the least 5000 (or 20%) of the county's population will be directly exposed to the development.

The predictable has occurred. Lake County now appears to be entangled in the archetypal energy/environment confrontation. This confrontation is especially intense because Lake County is, on a per capita basis, the poorest county in the state.

In the spring of 1975, a group of students enrolled in Conservation and Resource Studies 133 at the University of California, Berkeley, undertook an environmental study of geothermal development in a portion of Lake County under the direction of Professor J. McColl and P. Heffernan. One phase of this project was a poll of the opinions of Lake County's registered voters about geothermal development. A questionnaire, prepared by Gary Bachrach, Jeff Bodington, Peter Turnbaugh, and one of us (L.V.), was sent to 2500

registered voters (out of 15,000) in the county over the signature of D.F. Johnson, the Planning Director of Lake County. The costs of printing and mailing were borne by the county, and the other students in the class, plus the Lakeport High School Rainbow Girls, assisted with the mailing. 740 questionnaires were returned by May 30. The responses were tabulated by J. Bodington with computer time provided by the College of Natural Resources, University of California at Berkeley. This tabulation has been published as part of the University's report entitled Environmental Study of Prospective Geothermal Development in Big Canyon Creek Watershed, Lake County, June 1975.

The originators of the survey and the county itself have graciously allowed us to perform further detailed analysis on the data. We present the results of the analysis in this report. A total of 786 questionnnaires were received and analyzed as of July, 1975.

In addition to this survey, the authors will shortly publish a brief analysis of an identical survey taken among the registered voters of Cobb Valley. This survey was conducted by Mrs. Frank Frates and the Friends of Cobb. They attempted to contact every registered voter in Cobb Valley and received 142 responses (65%). Thus it will be possible to obtain a more accurate picture of public opinion in the Cobb Valley than is possible from the county survey.

II. The Questionnaire and a Simple Tabulation of the Responses

Figure 1 is a photoreproduction of the questionnaire which was sent out. The careful reader will note some technical errors in certain questions. We refer the reader to the technical appendix for a discussion of these problems.

In Table 1 we present the percentage tabulations of the responses to each question. In each case, only those respondents who answered the given question have been included in the percentages. Throughout the rest of the tables we employ suitable abbreviations for each question.

The responses to question 13 (see technical appendix) were grouped into three broad geographical zones: Southern (including the zip codes of Middletown, Cobb, and Lower Lake -- where most geothermal development is likely to occur), Northwest (including Finley, Kelseyville, Lakeport, Upper Lake, Lucerne, Nice, and Potter Valley), and Eastern (Clearlake Highlands, Oaks, Park, and Glenhaven). The zip codes included in each area and the approximate borders to the areas are shown in Figure 2.

The reader will note that Table 1 contains the tabulation of two questions which do not appear in the original questionnaire: the "Environmental Impacts Index" and the "Go-No Go Index." The response of each person to the Environmental Impacts Index was calculated by averaging his responses to questions 6 ("No objectionable odor"), 7 ("No objectionable noise"), and 12 ("No distracting visual impact"). All three were very highly correlated and the use of the Index considerably simplifies the discussion.

The response of each person to the Go-No Go Index was calculated by averaging his responses to the three original questions 1 ("Need economic expansion"), 9 ("I would lease my land"), and 10 ("Exploratory wells should be drilled"). The correlations among these variables were all positive and ranged near 0.4. We decided to employ the Go-No Go Index as a functional measure of the respondent's

Dear Friend:

I NEED YOUR HELP! Currently, numerous areas of Lake County are being leased for geothermal development. Your opinions are important to the process of planning for geothermal activity by those of us who deal with it on a day to day basis. Therefore, with the assistance of a team from the University of California, this questionnaire has been sent to you and to 2500 other registered voters in Lake County to determine some county-wide concerns. The University people will tabulate your responses and the results will be made public. Please help by filling out this stamped, self-addressed questionnaire and by dropping it in any mail box, soon. And, thank you for your help.

Sincerely,

Donald F. Johnson

Donald F. Johnson
Lake County Planning Director

P.S. I acknowledge - Any questionnaire is imperfect, but this one is better than none at all!

biw

Please rate statements 1 thru 12 by writing a number in the circle provided using this scale:

1 agree
2 conditionally agree
3 no opinion
4 mildly disagree
5 disagree

( ) (1) Lake County needs to broaden its economic emphasis to more than agriculture, tourism, recreation and retirement.

( ) (2) Geothermal development will increase jobs and tax revenue in Lake County.

( ) (3) The Geothermal corporations have the primary responsibility to plan and conduct steam exploration and production properly.

( ) (4) The economic benefits from geothermal development are more important than the environmental costs.

( ) (5) Non-regulated geothermal development is compatible with agriculture, tourism, recreation and retirement.

( ) (6) Geothermal development will not cause unusual odor problems.

( ) (7) Noise from geothermal development is not bothersome.

( ) (8) Geothermal development will not cause me to move or to shorten my stay in Lake County.

( ) (9) I would lease my land for geothermal development.

( ) (10) Exploratory wells should be drilled so that the size and location of the steam resource is known.

( ) (11) Geothermal development will raise property values if located in my immediate neighborhood.

( ) (12) The construction of power plants, transmission lines, pipelines and roads which result from geothermal development, will not cause offensive visual distractions.

Please "X" or otherwise indicate your responses to statements 13 thru 21.

(13) I live in or near (city, town or community).

_____

(14) I have lived in or maintained a home in Lake County 0-5 years (__); 6-15 years (__); over 15 years (__).

(15) I live in Lake County year round (__); seasonally (__); other _____.

(16) I own my home in Lake County (__); rent or lease (__); other _____.

(17) I own the mineral rights to my home property (__); owned by others (__); don't known (__); not applicable (__).

(18) I own more than ten (10) acres in Lake County (__); less than 10 acres (__); 10 to 40 acres (__); more than 40 acres (__).

(19) I am presently employed (__); self-employed (__); retired or semi-retired (__); other ___

_____.

(20) I enjoy the following types of recreation ("X" as many as may apply). Fishing (__); hunting (__); hiking (__); camping (__); boating (__); swimming (__) and/or wading in streams or lakes (__); swimming in pools (__); observing nature (__); golfing (__); relaxing and socializing outside the house (__); other ___

_____.

(21) I live in Lake County for the following reasons ("X" as many as apply): Born here (__); family roots or friends (__); employment base (__); retirement (__); natural environment (__); recreation opportunity (__); health reasons (__); housing availability (__); other _____

_____.

(22) I have visited a geothermal well site or power plant. Yes(__) No (__).

(23) Lake Co. geothermal should be prohibited (__); closely regulated(__); un-regulated(__).

Use the space below for any other comments or observations you may want to include.

_____

_____

Figure 1. Original questionnaire (original was 11" by 14").

Table 1.
Simple Percentage Tabulation of Responses

Q. #	Title	N	Agree 1	2	No Opinion 3	4	Disagree 5
1.	Need Econ Exp	781	63.9	12.8	1.4	4.9	17.0
2.	Increase Jobs & Tax Revenues	779	68.3	14.5	5.1	4.6	7.4
3.	Trust Geothermal Companies	772	58.7	17.6	6.1	3.8	13.9
4.	Economic Benefits > Environmental Costs	773	29.0	22.3	4.9	8.9	34.9
5.	Non- Regulated Development Compatible	772	15.3	10.4	7.4	7.3	59.7
6.	No Odor Impacts	774	21.7	12.4	26.7	13.0	26.1
7.	No Noise Impacts	771	24.1	12.7	22.7	13.4	27.1
8.	Would Not Move	774	70.0	8.4	7.0	4.1	10.5
9.	Would Lease	751	42.1	8.5	15.6	1.1	32.8
10.	Exploratory Wells	771	68.4	13.4	8.7	1.9	7.7
11.	Increase Prop. Values	770	23.9	10.5	24.4	9.6	31.6
12.	No Visual Impacts	768	30.3	17.6	11.2	13.5	27.3

13.	Geographic Location & Zip Codes (954 __)				N = 750	
	Northwest (35,51,53,58,64,69,84)				58.5%	
	East (22,23,24,43)				21.5%	
	South (26,57,61)				20.0%	
14.	Years of Residency in County	N	0-5	6-15	>15	
		783	34.7	28.5	36.8	
15.	I Live in Lake County	N	Year-round	Seasonal	Other	
		779	96.9	1.7	1.4	
16.	I:	N	Own Home	Rent	Other	
		779	88.1	7.8	4.1	
17.	Mineral rights owned by	N	Self Own	Others	D.K.	N.A.
		773	51.6	5.7	27.1	15.6
18.	Land parcel size	N	<10 Acres			>10 Acres
		686	63.3			36.7
19.	I am:	N	Employed	Self Employed	Retired	Other
		773	26.4	24.3	44.4	4.9

Table 1. Simple Percentage Tabulation of Responses (cont.)

20. I Enjoy the Following Types of Recreation: N = 786

	% Yes
Fishing	71.9
Hunting	36.3
Hiking	42.7
Camping	44.9
Boating	58.1
Swimming	49.4
Wading	35.0
Swimming in Pools	31.8
Observing Nature	65.3
Golfing	17.2
Relax & Socialize	75.8
Other	12.8

21. I Live in Lake County because: N = 786

	% Yes
Born Here	8.3
Family & Friends	33.8
Employment Base	31.7
Retirement Opportunities	50.4
Natural Environment	59.8
Recreation Opportunities	45.0
Health	30.3
Housing Availability	11.5
Other	11.6

22. I Have Visited a Geothermal Facility: N = 764

Yes	No
42.5	57.5

23. Lake County Geothermal Should Be: N = 751

Prohibited	8.0
Closely Regulated	84.7
Unregulated	7.3

	1	2	3	4	5
24. Go-NoGo Index (Average of Questions 1,9,&10) N = 745	51.4	16.5	15.8	8.6	7.7
25. No Environmental Impacts Index (Average of Questions) 6,7,&12) N = 761	24.3	14.6	22.6	12.2	26.3

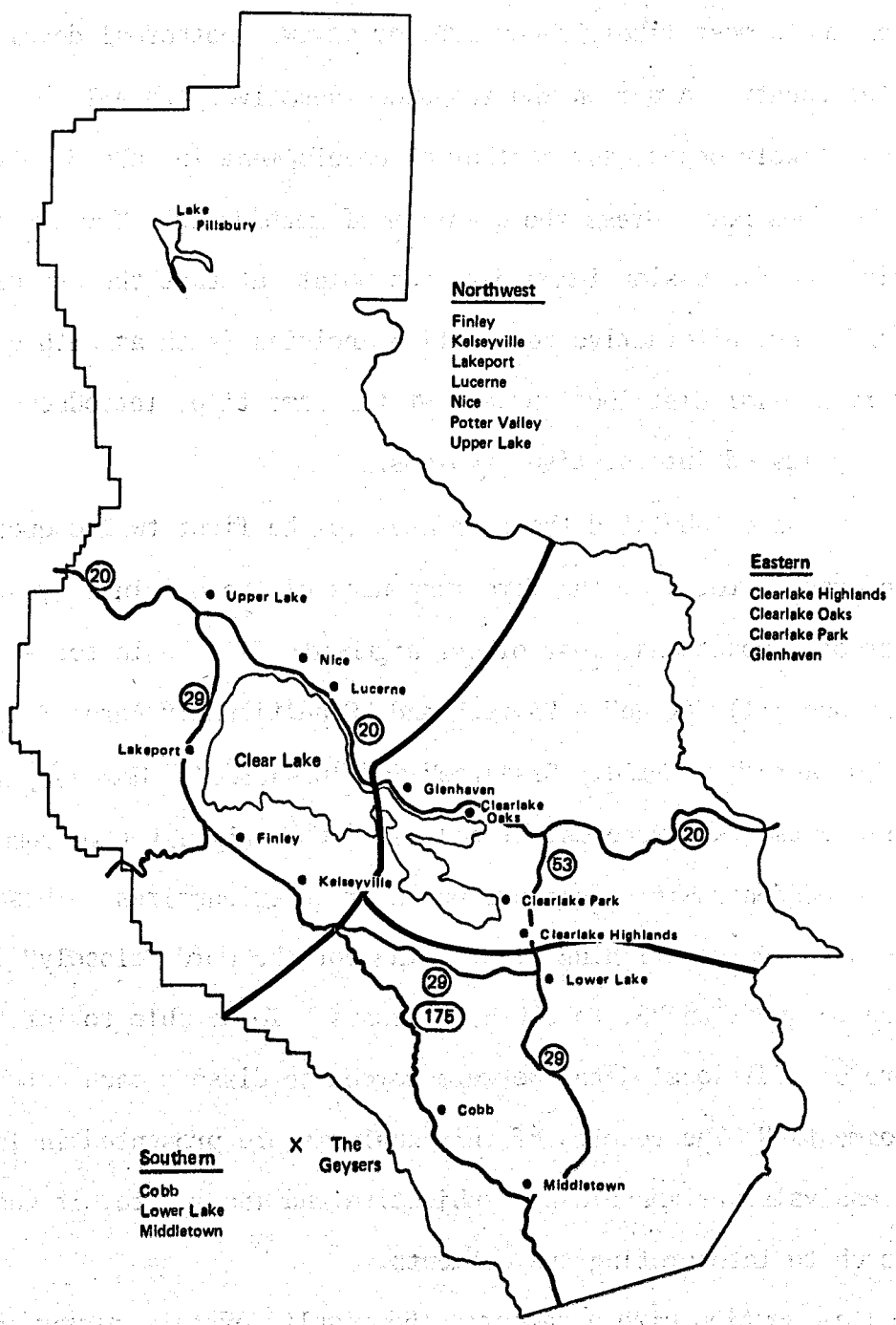

Figure 2. Geographical Zones Used in Survey Analysis of Lake County.

overall approval of whether the county should "go ahead" with geothermal development. By this we mean that a person who responded generally positively to all three questions would most likely encourage, or allow, geothermal development somewhere in the county. A person who responded negatively to all three questions would most likely oppose any geothermal development in Lake County. This "Go-No Go" index does not address the question of regulation. The use of this index simplifies the discussion immensely. We point out that the use of similarly intended but alternative combination indicies (such as with question 4) produces very similar distributions and at the same time, introduces a host of even more complicated interpretive problems.

In Table 1 we have tabulated the responses to the first twelve questions and the two Indices in terms of the five responses of the original questionnaire. In the interest of compactness, most of our arguments will be in terms of three aggregated responses: 1) "Agree" = "Agree" and "Conditionally Agree," 2) "No Opinion," 3) "Disagree" = "Mildly Disagree" and "Disagree". However, all correlation coefficients ("R") were calculated using the original five responses.

Over 300 respondents wrote comments on their questionnaires. These comments ranged all the way from underlining or crossing out the word "closely" in the second response to question 23, to 500-word essays. To be able to interpret this rich store of additional data, we were forced to dissect each actual comment into "monad comments." The results of this analysis are presented in Table 2. Although this analysis was unavoidably subjective and incomplete, it was the only possible approach to interpreting the comments.

We close this section with a caveat: the results of this survey should be taken with caution. The data and its analysis should not be considered the equivalent of the well known national public opinion polls, nor should it be considered a Lake County "referendum" on geothermal development. Certain groups

Table 2
Synthesis of Comments

Monad Comment	Cases Cited
Strictly regulated	48
Reasonably regulated	40
Nation needs energy	29
"Have it - use it"	25
Don't know enough about it	21
Could be good if properly controlled	17
Zone it out of certain areas	17
Environmentalists have gone too far	16
Don't trust developers	13
Development must be made to serve community needs	13
Don't want population growth or urbanization	11
Impacts could be controlled	11
Need more regulation	10
Have too much regulation	10
Lake County should get lower electrical rates and/or priority in the case of an energy shortage	9
Geothermal energy is relatively clean	8
Leave our beautiful county alone!	7
Development will benefit only "big interests" (other than geothermal companies)	6
Must have progress	6
Progress is not necessarily good	6
Must develop it for the future and/or future generations	5
County needs jobs to keep young people	5
Must conserve fossil fuels	4
Would like to visit geothermal sites	4
Should not be regulated by County	3
Geothermal is a desirable alternative to nuclear	3
Impacts need more study	3

are underrepresented in, or completely absent from, our sample population – the registered voters in Lake County. Young adults (who tend to have a low voter registration rate) and unregistered voters are not properly represented. Furthermore, the many people who have considerable investments in summer homes in the county, but who vote elsewhere, are absent. In addition, the survey was conducted in the springtime (before Memorial Day) so those registered Lake County voters who live there only during the summer are not properly represented. Finally, and probably most important, the returned questionnaires probably represent the most opinionated segment of the population. However, the financial and temporal constraints of the present survey preclude any attempt to overcome these and other problems.

III. The Influence of Demographic Variables upon Attitudes Toward Geothermal Development

The respondents are largely in favor of geothermal development. Over 75% of them indicate that the county needs to broaden its economic base, and over 75% favor exploratory wells. However, it is of interest to determine which demographic factors tend to predispose one toward or against geothermal development. We will first examine this question for the county as a whole and then look at the Southern geographic region alone. The solid support given geothermal development could still be qualified by fear of environmental impacts and/or the need for regulation, to be discussed later.

Table 3 shows that support for geothermal development is fairly evenly spread throughout the county. However, those respondents who live on or near the reservoir (South and East) are slightly more polarized on the question than those who live further away (Northwest). Length of residency has no real influence on attitudes towards development and neither does the size of one's land parcel. The weakness of these correlations is somewhat surprising. Employed persons are only slightly more in favor of geothermal development than retired persons. Surprisingly, whether or not one has visited a geothermal site or facility (question 20) has only a very weak effect — those who have visited are, of course, more likely to have an opinion.

In Table 4 we examine influences of recreational preferences and the reasons for living in Lake County, and we see some interesting, though weak, correlations. Those who hunt are the most likely to favor development (73.5%) and those who hike or observe nature are least likely to favor it (63.1% and 62.4%, respectively). (We wish to remind the reader that the "recreational" and "reasons for living" groups are not mutually exclusive.)

Table 3

Various Demographic Factors Relating to Go-NoGo Index

		% Go		% No Opinion		% NoGo	
13.	Geographic Locations						
	Southern County	69.3		10.7		20.0	
	Northwest County	66.9		18.5		14.6	
	Eastern County	69.6		13.5		16.8	
14.	Length of Residency in County		So.Co.		So.Co.		So.Co.
	0 - 5 years	67.0	61.0	15.9	4.9	17.0	34.2
	6 - 15 years	66.9	68.1	19.5	19.1	13.5	12.8
	More than 15 years	69.5	76.5	13.0	7.8	17.4	15.7
17.	Mineral Rights Ownership		So.Co.		So.Co.		So.Co.
	By Self	68.1	61.9	15.4	10.7	16.5	27.4
	By Others	68.3	100.0	19.5	0.0	12.2	0.0
	Don't Know	67.4	74.1	16.1	18.5	16.6	7.4
	Not Applicable	65.1	77.8	17.4	5.6	17.4	16.7
18.	Land Parcel Size						
	Own less than 10 acres	66.4		16.9		16.7	
	Own more than 10 acres	69.1		14.2		16.6	
19.	I am:						
	Employed	70.3		14.6		15.1	
	Retired	66.3		16.4		17.3	
22.	Have Visited Geothermal Site	68.2		13.8		18.0	
	Have Not Visited Site	67.2		17.7		15.1	
24.	Total Go-NoGo Index	67.9		15.8		16.3	

Table 4

Recreational Activities and Reasons for Living in County

Influence on Go-No Go Index

		Whole County		Southern County (only)	
20.	Recreational Activity	% Go	"R"	% Go	"R"
	Fish	67.1	.018	67.4	.049
	Hunt	73.5	-.074	75.4	-.146
	Hike	63.1	.081	60.6	.133
	Camp	66.3	.018	64.1	.065
	Boat	67.1	.018	71.6	.013
	Swim	64.8	.058	63.1	.154
	Swim in Pools	63.0	.068	66.1	.051
	Observe Nature	62.4	.126	65.0	.113
	Golf	67.9	.002	67.8	-.002
	Relax & Socialize	66.9	.024	67.0	.043
21.	Reasons for Living in Lake County				
	Born Here	66.7	.008	87.5	-.064
	Family & Friends	66.8	-.012	78.0	-.123
	Employment	74.7	-.122	84.1	-.257
	Retirement	67.2	.020	70.8	-.077
	Natural Environment	63.1	.110	63.8	.108
	Recreation	63.6	.055	70.5	.017
	Health	62.4	.065	57.8	.104
	Housing	73.5	-.028	77.8	-.026
	Averages	67.9	----	69.3	----

The effects of the reasons for living in Lake County are only slightly stronger. The strongest support appears among those who have settled in the county for reasons for employment or housing, and weakest support is among those who live there for reasons of health, recreational opportunities, or natural environment. Retirement as a reason for residing in the county has no effect.

The data for the Southern region alone* show a few significant differences. Southern respondents who have lived in the county less than five years are more likely to oppose geothermal development, and those who have lived in the county for more than fifteen years are significantly more likely to support development. Also, surprisingly, Southern respondents who own the mineral rights to their land are the least likely to support development, and those whose mineral rights are owned by someone else are all in favor of development. We find this to be inexplicable in terms of available data, unless these people are in fact leased to geothermal companies. The effects of recreational preferences among Southern respondents are, for the most part, in the same direction but mildly stronger than county wide. Those southern respondents who live in the county because of employment, family and friends, or because of being born there, are more likely to be pro-development, and even more so than is the case county wide.

To summarize, there are no county wide demographic groups (identifiable in terms of the present data) which are either considerably more in favor or more against geothermal development. However, in the Southern county alone length of residence, mineral rights status and living in the county for reasons of employment do have significant effects upon attitudes toward geothermal development.

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* In the interest of brevity, the questions which are not significantly different from the county-wide pattern are not dealt with here for the southern region.

IV. Patterns of Support for Geothermal Development

In the preceding section we found that the "demographic" factors have only weak effects upon attitudes toward the prospect of geothermal development. However, the responses to the first twelve "attitude" questions manifest strong interrelations. All of the correlation coefficients between the responses to these twelve questions are positive and range from about 0.2 to 0.7. Since all twelve questions are parallel in that a positive response to any one is "for" geothermal development, we see that there is a strong tendency for the respondents either to support or reject all of the twelve propositions together. Factor analysis of the covariance matrix confirms this. The greatest spread in the space of these twelve questions is about twice as great as the next greatest spread. The eigenvector corresponding to the greatest spread is essentially an arithmetic average of the twelve questions. We shall see, however, that there are fairly distinct "environmental" and "economic" determinants of response.

The largest correlation coefficients are those between the three environmental impact questions 6, 7, and 12 (odor, noise, and visual). These three variables all correlate between 0.6 and 0.7 in magnitude. Of course, a respondent's opinion of one impact may determine his perception of the others, or all three impacts may tend to be associated and perceived together. And here could be a case of ex post rationalization on the part of the respondent.

Since the demographic variables are found to have little effect upon the responses to the Go-No-Go Index, other factors must be sought within the first twelve questions themselves. Table 5 lists the R correlations with the Go-No Go Index of some of the possible independent variables. The three highest values are the correlations between the Environmental Impacts Index, question 2 ("Increased jobs and tax revenues"), and question 4 ("Benefits greater than costs"). Since question 4 is largely redundant, we chose the Environmental Impacts Index and question 2 as the independent variables.

Table 5

Selected Correlations With Go-NoGo Index

	"R" (with Go-NoGo)
2. Increase Jobs & Tax Revenues	.571
3. Trust Geothermal Companies	.469
4. Benefits > Costs	.568
5. Nonregulated Development is Compatible	.332
11. Increase Property Values	.426
25. No Environmental Impacts Index	.592

In Figure 3 we present a three-dimensional plot of the joint distribution of the responses to the Environmental Impacts Index, question 2, and the Go-No Go Index. (As only thirteen respondents fall on those points which are not visible, we omit them in the figure). On this diagram we have designated four "corner" groups of respondents as A,B,C, and D for purposes of discussion.

Group A, which includes those people who see no environmental impacts, expect increased jobs and tax revenues, and support geothermal development, contains 260 people or approximately one-third of all respondents and is, therefore, by far the largest group in the figure. Group D contains those who perceive negative environmental impacts, expect no economic benefits, and are, of course, against development. Most of the respondents fall on a broad swath stretching from A to B and then down to C, while group D comprises an isolated maximum.

The most striking feature of this distribution is that of the 447 respondents who see no impacts, or are undecided about the impacts, 394 (or 88%) favor geothermal development. Of these 394, 377 (or 84% of the total) also expect

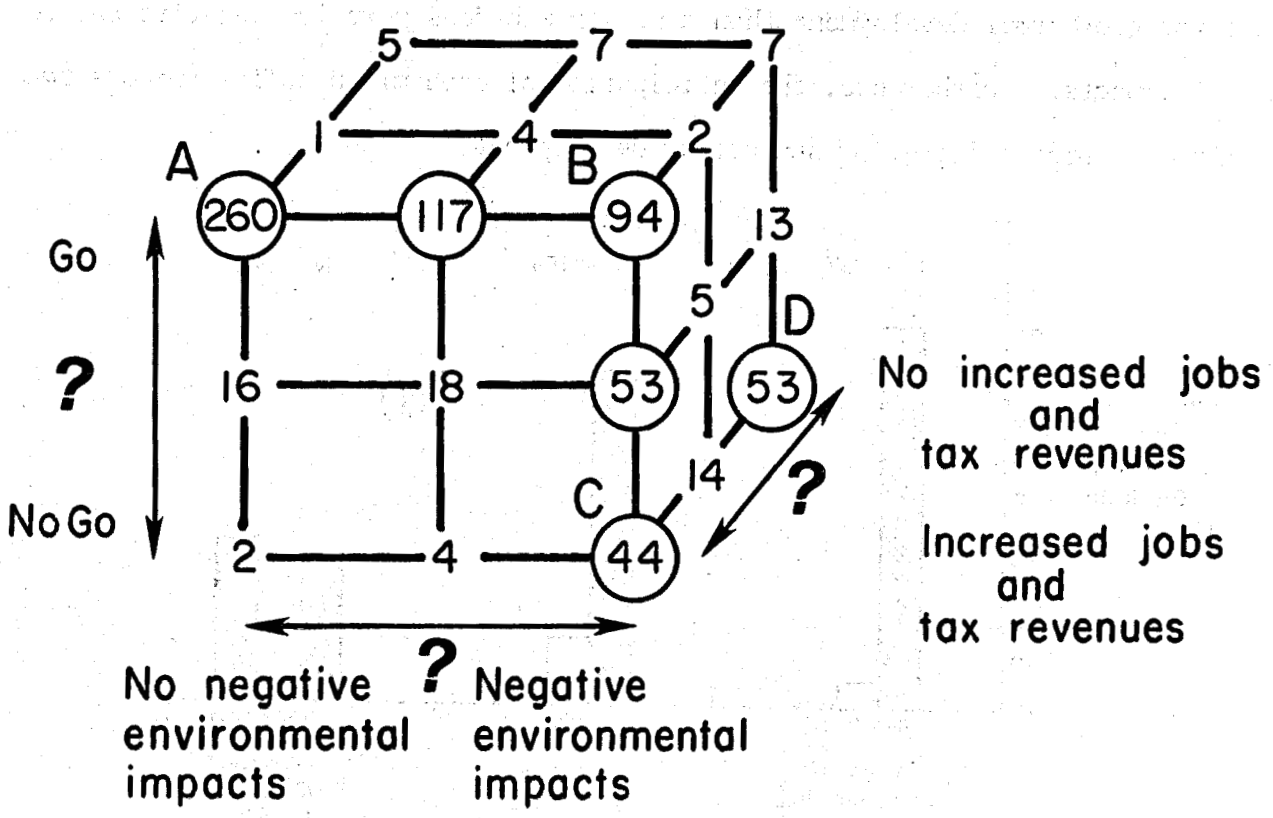

Figure 3. Joint Distribution of Three Variables: (25.) No Environmental Impacts Index; (24.) Go-No Go Index; and (2.) Increased Jobs and Tax Revenues. Total N = 731; 13 respondents in portions of cube that are not shown.

geothermal development to increase job opportunities and tax revenues. However, among the 285 respondents who perceive environmental impacts, only 103 (or 36%) favor geothermal development. Of these 103 who favor the development despite their perception of deleterious impacts, 94 expect economic benefits. Finally, among the 124 respondents who either see no economic benefits or are uncertain about the economic benefits, regardless of perception of environmental impacts, only 26 (or 12%) favor geothermal development (see Figure 4).

We are led to conclude that the absence of a strong perception of negative effects virtually guarantees support of geothermal development and the anticipation of economic benefits. More precisely, a person who does not perceive environmental impacts or is uncertain about them is nearly 2½ times more likely

to favor geothermal development than a person who does perceive negative environmental impacts. Furthermore, the anticipation of economic benefits appears to be almost a prerequisite for supporting development.

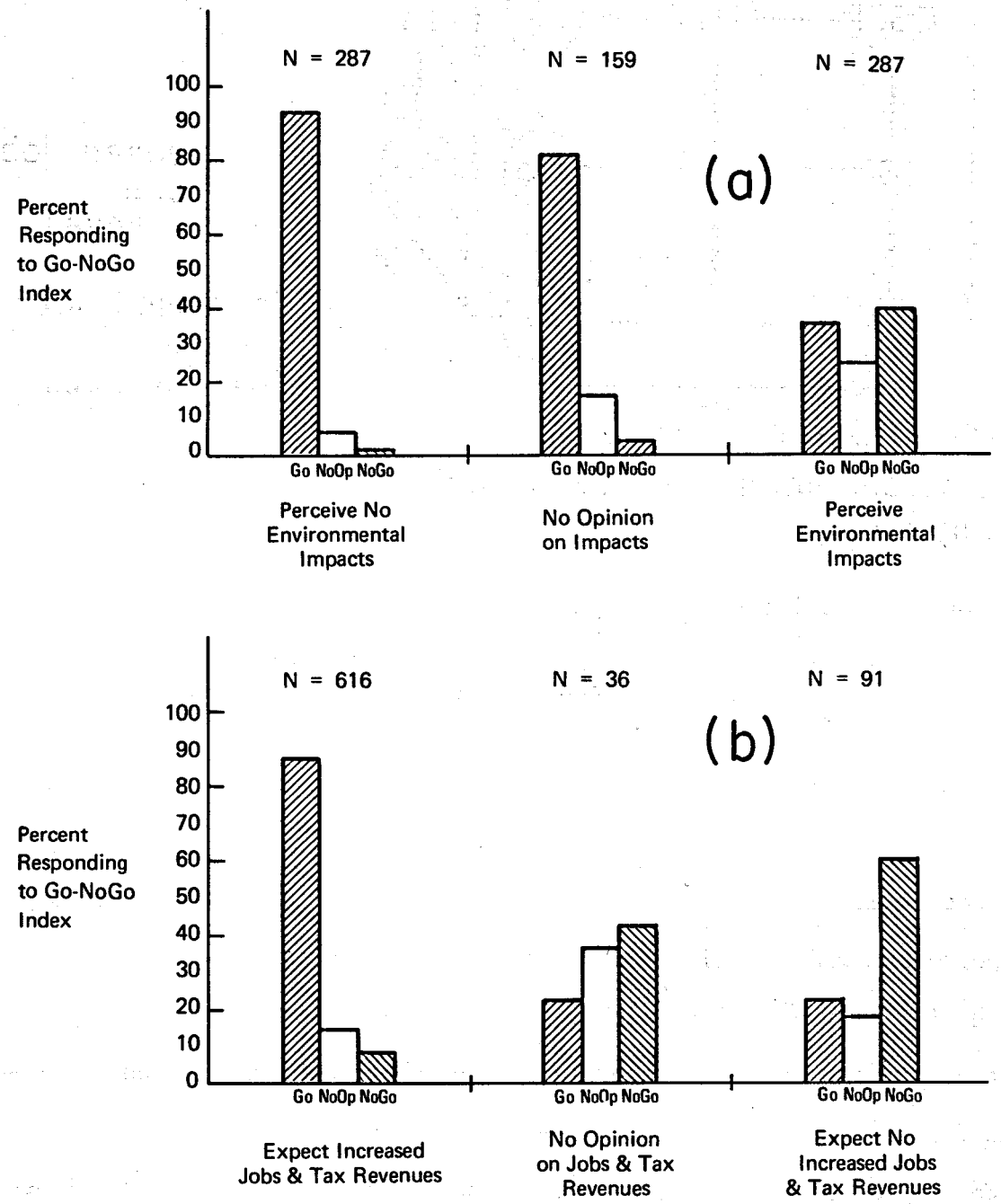

Figure 4. (a) The Relationship of the Perception of Environmental Impacts and Go-No Go Index.
(b) The Relationship of the Expectation of Increased Jobs and Tax Revenues and Go-No Go Index.

V. The Gradation of Opinion

The groups of respondents whom we have designated A, B, C, and D range in that order, from being strongly pro-geothermal to being strongly anti-geothermal. We now turn to a closer examination of the progression of opinions from group A to group D. This progression is shown in Table 6.*

The influence of the demographic factors is again seen to be weak. Group A respondents are more likely to enjoy hunting than the county average, and less likely to enjoy hiking and observing nature. The opposite is true of the other three groups. Thus the perception of impacts (which distinguishes groups B, C, and D from group A) is disproportionally associated with hiking and observing nature. Through their influence on perception of impacts, recreational preferences seem to affect the general attitude toward geothermal development. The same may be said of the influences of "natural environment" and "health" as reasons for living in Lake County.

The pattern of responses concerning employment status indicates that group B stands out (compared to groups C and D) in that its members are more likely to be employed and to live in the county for employment opportunities.

* We remind the reader that the Environmental Impact Index is an average of questions 6, 7, and 12, and that the Go-No Go Index is an average of questions 1, 9, and 10. Only those demographic questions are included in Table 6 which present a meaningful variation from group to group. Furthermore, groups B, C, and D are rather small and so their tabulations are somewhat unreliable. Therefore, the numbers in these smaller groups must be considered approximate, and only general patterns should be trusted. We also caution the reader that groups A,B, and C are merely "slices" taken from a continuous distribution which stretches from A to C rather than distinct clusters. They are mere samples taken from the two ends and the middle of this continuum rather than actual distinct opinion groups.

Table 6
Group Tabulations (Vertical %)

	Group		A (N = 260)	B (N = 94)	C (N = 44)	D (N = 53)	Whole County (N ≈ 786)
19.	I am:	Employed	25	36	30	22	26.4
		Self-Employed	26	22	20	29	24.3
		Retired	46	37	43	47	44.4
		Other	3	5	7	2	4.9
20.	I enjoy:	Hunting	46	29	30	34	36.3
	(% "Yes")	Hiking	34	50	50	53	42.7
		Observing Nature	56	74	80	68	65.3
21.	I live in Lake County for:						
	(% "Yes")	Employment	35	36	20	17	31.7
		Natural Environment	53	69	77	62	59.8
		Health	25	37	39	36	30.3
22.	Visited geothermal site?						
		Yes:	51	40	41	57	42.5
		No:	49	60	59	43	57.5
23.	Geothermal development should be:						
		Prohibited:	2	0	14	55	8.0
		Closely regulated:	80	100	86	45	84.7
		Unregulated:	18	0	0	0	7.3
25.	No. Env. Impacts Index	Agree	100	0	0	0	38.9
		?	0	0	0	0	22.6
		Disagree	0	100	100	100	38.5
6.	No Odor Impacts	Agree	81	4	0	2	34.1
		?	18	14	11	9	26.7
		Disagree	1	82	89	89	39.1
7.	No Noise Impacts	Agree	84	5	0	2	36.8
		?	13	10	7	4	22.7
		Disagree	3	85	93	94	40.5
12.	No Visual Impacts	Agree	92	10	7	2	47.9
		?	5	10	2	6	11.2
		Disagree	3	80	91	92	40.8

Table 6 (cont'd)

Group		A (N = 260)	B (N = 94)	C (N = 44)	D (N = 53)	Whole County (N ≈ 786)
24. Go-NoGo Index	Agree	100	100	0	0	67.9
	?	0	0	0	0	15.8
	NoGo	0	0	100	100	16.3
1. Economy Needs Expansion	Agree	97	96	12	9	76.7
	?	1	0	2	2	1.4
	Disagree	2	4	86	89	21.9
9. Would Lease	Agree	78	63	2	0	50.6
	?	14	20	0	0	15.6
	Disagree	8	17	98	100	33.9
10. Expl. Wells be Drilled	Agree	97	94	45	21	81.8
	?	1	6	25	11	8.7
	Disagree	2	0	30	68	9.6
2. Increased Jobs & Tax Revenues	Agree	100	100	100	0	82.8
	?	0	0	0	0	5.1
	Disagree	0	0	0	100	12.0
3. Trust Companies	Agree	92	81	46	25	76.3
	?	2	5	9	7	6.0
	Disagree	6	14	45	68	17.7
4. Benefits > Costs	Agree	86	39	0	0	51.3
	?	5	4	2	8	4.9
	Disagree	9	63	98	92	43.8
5. Nonregulated Development Compatible	Agree	54	7	2	4	25.6
	?	7	4	0	2	7.4
	Disagree	39	89	98	94	67.0
8. Would Not Move	Agree	98	76	41	21	78.4
	?	1	13	9	10	7.0
	Disagree	1	11	50	69	14.6
11. Increase Property Values	Agree	58	28	16	11	34.4
	?	22	18	11	10	24.4
	Disagree	20	54	73	79	41.2

We speculate that the respondents in this group, even though they do perceive impacts, tend to view them as less important than the expected economic benefits. Hence group B's support for geothermal expansion and group C's opposition.

Other explanations are also conceivable. For example, group B respondents could be motivated by the consideration that "the nation needs energy," perhaps even to the extent that they will tolerate environmental impacts for the nation's sake. Or a desire for personal profit could override any other consideration. We tentatively conclude, based upon a check of the other responses to questions 4, 9, 11, and 18 and of the comments of group B, that these motivations, while present, are not widespread. In fact, the only outstanding thing about the comments is that they disproportionately tend to stress regulation.

The fractions of each group who had visited geothermal sites show only that the members of the two extreme groups A and D are considerably more likely to have visited a geothermal site than the members of the two intermediate groups.

The distribution of responses to questions 1 and 9 closely follows that of the Go-No Go Index. The responses to question 10 are, however, quite different. In particular, 45% of the respondents in group C still approve of exploratory wells, and even 21% of group D still do. Thus, groups B and C are differentiated more by their responses to questions 1 and 9 than by their responses to 10.

What is most striking about the pattern of responses to question 10 is how closely it resembles the pattern of responses to questions 3 and 8. When viewed together with the components of the Go-No Go Index (1 and 9), these questions provide a gradual variation of definition of groups A to D. Groups A and B seem more inclined to participate personally in development (question 9), while for groups C and D the issue shifts from participation to toleration and trust of development and the companies. We hypothesize that associated with the

gradual loss of trust and toleration of geothermal development, from group A to D, is a "threshold" point at which the respondents become very unwilling to participate or support development. Hence, the large distinction between Groups B and C for questions 1 and 9 is caused by a gradual shift between B and C for questions 3, 8, and 10 past the "threshold" point.

The variation of the four groups on the question of regulation also follows the gradual shift pattern. However, in groups C and D, there are fewer respondents who favor prohibition than indicate they would move because of geothermal development. On the basis of their comments, we believe that this is due to the resignation of many of these "non-tolerators" to the inevitability of development. Those among them who do not favor prohibition strongly tend to emphasize the need for severe regulation and zoning. It is noteworthy that even within strongly pro-geothermal group A, only 54% of the respondents feel that unregulated development is compatible with the county's present economic activities, and only 18% favor unregulated development. None of the respondents within the other three groups favor unregulated development, and only a few feel that unregulated development would be compatible with other activities.

We now summarize the progression of opinion from group A to group D. The group A respondents see no negative environmental impacts, expect economic benefits, and are willing both to tolerate development and to participate actively in it. The group B respondents perceive negative environmental impacts, but expect economic benefits, and apparently decide, on at least partially economic grounds both to tolerate development and to participate in it. The group C respondents still expect economic benefits but are definitely not willing to participate. Finally, the group D respondents do not expect economic benefits and most of them are not even willing to tolerate development. A majority of them ask for complete prohibition.

VI. The Perception of Environmental Impacts

In Section IV we saw that the perception of environmental impacts is the strongest single determinant of attitude toward geothermal development. However, in Section III we found that whether or not a respondent had visited a geothermal site had little effect upon his attitude toward geothermal development. This is surprising in that it contradicts a seemingly popular hypothesis: When people visit geothermal facilities, they perceive environmental impacts directly, and tend to come home less supportive of development. Table 7 reveals the fatal flaw in this argument: those who have visited facilities are actually less likely to perceive impacts. Thus, there is a possibility that a visit to a site does produce a positive impression on visitors and that those who fear impacts are mostly people who have not visited the facilities themselves and are imagining impacts because of an anti-geothermal bias. This hypothesis is, however, incorrect because there is no relationship between visiting a site and the Go-No Go Index. Specifically, 47% of all anti-geothermal respondents had visited a site, whereas 43% of the pro's had done so. Thus opponents have visited geothermal facilities as often as proponents.

This, however, does not rule out the possibility of bias, and Table 7 reveals that this is indeed the case. The influence of visiting a geothermal facility upon the perception of environmental impacts varies greatly depending upon one's attitude toward development. Among those respondents who favor development, visiting a site reduces the perception of impacts. Yet, for opponents of development, visiting a site has no significant effect, because essentially all of these people perceive impacts. Finally, those who have not made up their minds regarding geothermal development are more likely to perceive impacts if they have visited a site. Apparently these "unbiased" people are displeased by what they see at a geothermal site.*

Table 7

Influence of Visiting a Geothermal Facility
Upon Go-NoGo Index and Perception of Environmental Impacts

Factor	(22.) Visited Geo. Facility	Whole County % Agree	% ?	% Disagree	R
24. Go-NoGo Index	Yes	68.2	13.8	18.0	
	No	67.2	17.7	15.1	.003
25. No Environmental Impacts Index	Yes	43.3	17.6	39.0	
	No	35.2	26.5	38.3	.058

Influence of Visiting a Geothermal Facility
Upon Perception of Environmental Impacts
Controlled for Go-NoGo Index

(24.) Control Response	(22.) Visited Geo. Facility	Whole County % No Impacts	% ?	% Yes Impacts	R
Go	Yes	62.2	20.1	17.7	
N = 485	No	46.4	31.2	22.4	.157
?	Yes	9.4	16.3	74.4	
N = 116	No	20.5	24.7	54.7	-.162
NoGo	Yes	0.0	3.6	96.4	
N = 117	No	3.2	4.8	91.9	-.136

We conclude that the explanation for the positive influence that visiting a geothermal facility has on the perception of environmental impacts rests on the fact that the proponents (68%) so outnumber opponents that their strong positive shift more than cancels out any opposite relationship of opponents and "undecideds".

In Table 8 we present the same data for the 150 respondents who live in the southern portion of the county alone. Essentially the same pattern is evident, but it is more pronounced. Among the southern respondents, visiting a site is correlated with a greater shift toward not perceiving impacts. Again this is apparently because the pro-geothermal respondents within this group are less likely to perceive impacts if they have visited a site, and this shift is more prounced than for the county as a whole (see Figure 5).

The southern county respondents are more likely to perceive impacts and are, of course, more likely to have their minds made up regarding the impacts. This greater perception of impacts is reflected in Table 9 in the southern respondents' greater likelihood of considering the costs of geothermal development to be greater than the benefits.

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* Of course, all this casts some doubt upon our assumption in Section IV: that the perception of environmental impacts determines the respondents' general attitude toward geothermal development. As we have seen, at least in the case of some people, the influences goes the other way. Unfortunately, the available data do not allow the relative weights of the two possible directions of influence to be determined.

The same is undoubtedly true of the interrelation of the expectation of economic benefits and attitude toward geothermal development and, more generally, of the interrelations of the responses to all of the twelve attitude questions.

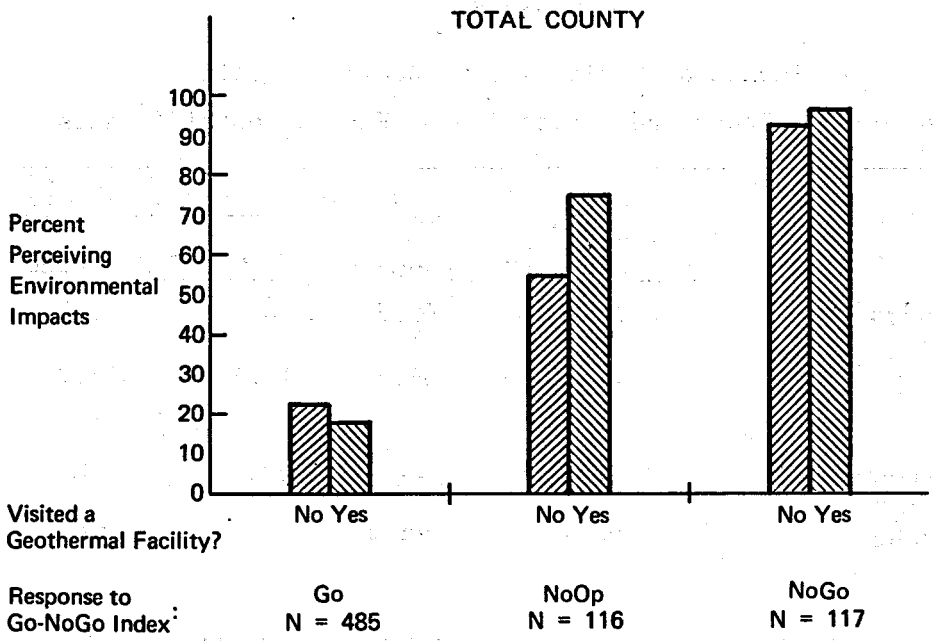
Table 8

Influence of Visiting a Geothermal Facility
Upon Go-NoGo Index and Perception of Environmental Impacts

	Factor	(22.) Visited Geo. Facility	Southern County only % Agree	% ?	% Disagree	R
24.	Go-NoGo Index	Yes	69.8	8.1	22.1	
		No	66.7	16.7	16.7	.023
25.	No Environmental	Yes	45.5	11.4	43.2	
	Impacts Index	No	23.0	19.2	57.7	.167

Influence of Visiting a Geothermal Facility
Upon the Perception of Environmental Impacts
Controlled for Go-NoGo Index

(24.) Control Response	(22.) Visited Geo. Facility	Southern County only % No Impacts	% ?	% Yes Impacts	R
Go	Yes	65.5	13.8	20.7	
N = 90	No	28.1	28.1	43.8	.306
?	Yes	14.3	14.3	71.5	
N = 15	No	12.5	0.0	87.5	.149
NoGo	Yes	0.0	0.0	100.0	
N = 27	No	0.0	0.0	100.0	-----



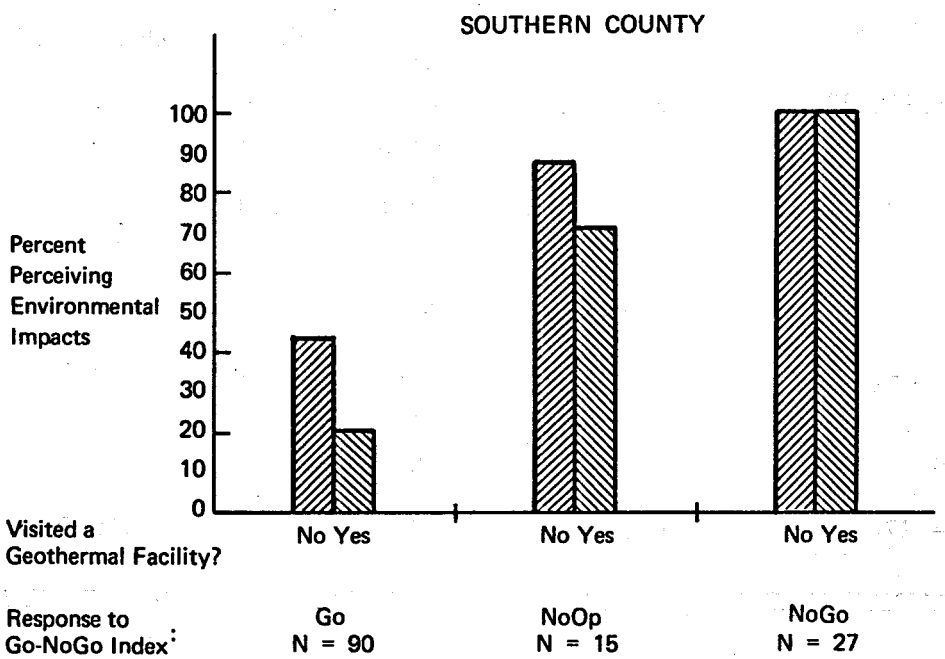


Figure 5. Influence of Visiting a Geothermal Facility Upon the Perception of Environmental Impacts Controlled for Go-No Go Index: A Comparison of County and Southern County Biases.

Table 9

Geographic Influence on Perception of Environmental Impacts
and Net Benefits of Geothermal Development

13. Geographic Area:	(24.) No Env. Impacts Index: % No Impacts	?	% Yes Impacts		(4.) Economic Benefits > Environmental Costs: % Agree	%?	% Disagree
Southern	37.2	13.8	48.9	Southern	43.5	4.8	51.7
Northwest	39.5	25.1	35.4	Northwest	52.7	5.8	41.6
Eastern	41.7	21.2	37.1	Eastern	54.1	3.8	42.0

Effect of Length of Residence
Upon Perception of Environmental Impacts

14. Lived in County	(Whole County) (25.)No Env. Impacts Index: % No Impacts	%?	% Yes Impacts		(Southern County) (25.)No Env. Impacts Index: % No Impacts	%?	% Yes Impacts
0-5 years	37.7	23.1	39.2	0-5 years	26.1	15.2	58.7
6-15 years	38.4	22.2	39.4	6-15 years	33.3	20.8	45.8
> 15 years	40.7	22.5	36.7	> 15 years	52.0	6.0	42.0
		R = -.024				R = -.170	

In Table 10 we examine the effects of recreational preferences, reasons for living in Lake County, and length of residence upon perception of impacts. It is evident that those who hike, swim, or observe nature, or live in the county for reasons of natural environment, recreation, or health, are somewhat more likely to perceive impacts. This is reasonable since all of these recreational activities depend upon the quality of the natural environment. Interestingly, hunters perceive fewer impacts. The pattern of correlations among the southern respondents is similar to that of the whole county, except for those southerners who live in the county because they were born there or because of employment or retirement. These people are somewhat less likely than other southerners to perceive environmental impacts and are even less so inclined than their counterparts in the county as a whole. Length of residence has no effect county wide, but shorter term residents in the southern county are more likely to perceive impacts. In general, the other "demographic" influences upon perception of impacts show a similar pattern to those upon attitudes toward development both county-wide and in the southern region alone.

Table 10

Factors Relating to

The Perception of Environmental Impacts

	Whole County		Southern County	
20. Recreational Activity	% Yes Impacts	"R"	% Yes Impacts	"R"
Fish	39.6	-.003	47.6	-.047
Hunt	31.3	-.108	38.9	-.136
Hike	46.0	.128	62.5	.188
Camp	40.3	.041	50.0	.022
Boat	39.9	.040	48.7	.044
Swim	44.5	.126	57.9	.202
Swim in Pools	44.4	.094	51.9	.107
Observe Nature	45.6	.147	52.8	.071
Golf	39.1	.016	48.3	.049
Relax & Socialize	39.9	.051	50.5	.065
21. Live in County Because:				
Born Here	37.5	-.006	12.5	-.090
Family & Friends	37.1	-.023	45.2	-.011
Employment	31.7	-.065	36.6	-.118
Retirement	39.1	-.006	42.3	-.183
Natural Environment	44.7	.139	56.7	.165
Recreation	42.2	.072	53.1	.087
Health	49.5	.123	63.0	.118
Housing	40.2	.005	63.6	.066
Averages	38.5	----	48.9	----

VII. The Regulation of Geothermal Development

Although a large majority (68%) of the respondents favor geothermal development, an even larger majority (85%) favor close regulation of development if it does indeed occur. As noted in Section V, 80% of the respondents within the most strongly pro-geothermal group A still favor close regulation.

In Section V we also saw that attitudes toward regulation are strongly influenced by the perception of environmental impacts. It seems likely that attitudes toward regulation should, more generally, be influenced by the respondents' anticipation of the trade-off between environmental impacts and economic benefits. Theoretically, one would predict that all who favored non-regulation would also see no environmental impacts and expect economic benefits to outweigh environmental costs, and thus be pro-geothermal. Secondly, prohibitionists would fear environmental impacts and not expect any economic benefits to outweigh those impacts, and thus be anti-geothermal. Thirdly, those who saw impacts and/or trade-off losses and still favored development should be the strongest in favor of regulation.

Table 11 depicts the results of these various tabulations. As predicted, the largest percentage of non-regulation supporters occurs among those who feel the county should go ahead with geothermal development, and that it will produce a net benefit. This position is taken by 89% of all those who favor non-regulation.

Also as predicted, the largest amount (68%) of those who favor prohibition also feel that geothermal development will produce a net loss and that the county would do best not to go ahead with it.

Thirdly, of those respondents who feel geothermal development would produce a net loss <u>but</u> that the county should go ahead with it anyway, 96.3% call for close regulation. This clearly shows that these respondents feel that

Table 11

Influence of Selected Responses*
to Go-NoGo Index and Benefits
and Costs Upon the Support of Regulation
Independent Variable Combinations

Type of Regulation	(24.) (4.)	Go B>C	Go B<C	NoGo B<C	Horizontal Total*
Vertical Percentages					
23. Prohibited		1.5	1.5	35.8	—
Closely Regulated		84.2	96.3	64.2	—
Un-Regulated		14.2	2.2	0.0	—
Vertical Total		99.9	100.0	100.0	
Horizontal percentages*					
23. Prohibited		8.8	3.5	68.4	70.7
Closely Regulated		45.8	21.3	11.5	78.6
Un-Regulated		88.7	5.7	0.0	94.4
N		330	134	109	573

*Horizontal percentages do not sum to 100% due to omission of data for 144 respondents of various other combinations of the independent variables.

geothermal expansion needs to be restricted or controlled so that the incompatibilities are reduced and the net balance becomes positive.

Among respondents who feel that the net impacts will be positive and that the county should go ahead with development, the vast majority (84%) still supported regulation.

It is striking that, county wide, 25.7% of the respondents feel that unregulated development is compatible with present economic activities, while only 7.3% favor unregulated development. This discrepancy is even more pronounced among the respondents of the previously introduced group A, for whom the corresponding percentages are 54 and 18, respectively. Two possible explanations for this discrepancy present themselves: first, that the respon-

dents take noneconomic considerations into account when considering the need for regulation, and second, that most of those who feel that unregulated development might be tolerable are simply unwilling to support it for fear of being proven wrong. We know that the first is true, and the second is also likely to be important.

In closing this section, we wish to emphasize that in no way do the data support the much discussed contention that there is a "backlash" against environmental concerns. This is most evident from the distribution of comments. To be sure, 10 respondents commented "too much regulation." However, an equal number commented "Need more regulation." Likewise, 16 commented "Environmentalists have gone too far," while 13 commented "Don't trust developers," and 48 emphasized "strict regulation," while 40 preferred "reasonable regulation." On the basis of these comments and of the equally symmetric distribution of responses to question 23, we concluded that extremes of opinion concerning regulation are rare and roughly balanced in Lake County.

VIII. The Willingness to Lease Land for Geothermal Development

In this section we examine the effects of various factors upon willingness to lease land for geothermal development (i.e., responses to question 9) in the county as a whole and in the southern region alone. Only those factors are considered which seem most likely to influence directly the willingness to lease and actually do show a significant effect.

Unfortunately, question 9 is somewhat ambiguous in that it can be interpreted in two ways: either "I would lease my land if I had enough to lease" (the intended interpretation) or "I would lease the land that I actually have." Fortunately, our data does allow us to determine which of these interpretations our respondents chose. If people had chosen the second alternative, then we would expect the responses to the leasing question to be significantly different between those who: do or do not own their mineral rights, do or do not own large parcels of land, or do or do not live in potentially developable (southern) areas. Table 12 shows that in each of these cases there is no significant variation in responses to the willingness to lease. We conclude that most respondents actually chose the first interpretation, which allows us to examine the influences of the other factors without worrying about the possible influence of land ownership or about the ambiguity in question 9.

It is interesting that 81.8% of the respondents feel that exploratory wells should be drilled, while only 50.6% would lease their land. Since we have eliminated the possibility of place of residence, mineral ownership, and land parcel size, other factors must be sought. From the bottom of Table 12 it is apparent that the perception of environmental impacts correlates most highly with the willingness to lease. There are, of course, other less important factors. In almost every case, each factor is stronger in the southern region. We conclude that the most important influence upon the willingness to lease and one which

Table 12

Various Factors Influencing
The Willingness to Lease
for Geothermal

17. Mineral Rights Ownership	(9.) Willing to Lease % Agree	% ?	% Disagree
Whole County	51.0	51.2	33.8
Owned by Self	53.9	10.1	36.0
Owned by Others	51.3	22.0	26.9
Don't Know	46.9	18.0	35.0
Not Applicable	48.7	24.8	26.6
Southern County (Only)	54.4	11.6	34.0
Owned by Self	51.7	5.7	42.5
Owned by Others	66.7	16.7	16.7
Don't Know	59.2	18.5	22.2
Not Applicable	55.6	27.8	16.7

Correlations to Willingness to Lease (9.)	Whole County N ≈ 786 R	Southern County N ≈ 150 R
18. Land Parcel Size	-.085	.004
14. Length of Residence	-.104	-.189
21. Live...For Employment	-.121	-.259
21. Live...For Natural Env.	.087	.147
21. Live...For Recreation	.048	.064
21. Live...For Health	.086	.146
22. Visit Geo. Facility	.073	.102
3. Trust Geo. Companies	.340	.474
11. Increase Prop. Values	.396	.513
6. No Odor Impacts	.477	.566
7. No Noise Impacts	.500	.623
12. No Visual Impacts	.489	.668
25. No. Env. Impacts Index	.538	.669

accounts for much of the above discrepancy is the perception of environmental impacts. There are many respondents who support development but who are unwilling to tolerate it in their immediate vicinity because of fear of environmental impacts and/or declining property values.

The fact that one has visited a geothermal site has an interesting opposite effect from that expected. The survey shows that those who have visited geothermal facilities are slightly more willing to lease than those who have not. The relationship is even stronger for residents of the southern county. To check for the possibility of bias (as in Section VI), the effect of visiting a site upon the willingness to lease was controlled for Go-No Go attitude. Table 13 shows the same phenomenon. For pro-geothermal respondents, a visit to a site is correlated with being more willing to lease, while for anti-geothermal people it has no effect -- they still refuse to lease.

Table 13
Effect of Visiting a Geothermal
Facility (or Site) Upon The Willingness
to Lease, Controlled for Go-NoGo

(24.) Control Response	(22.) Visited a Geo. Site	(9.) Willing to Lease % Agree	% ?	% Disagree	R
Go	Yes	80.7	10.4	8.9	
N=493	No	66.2	20.3	13.5	.143
?	Yes	11.7	23.3	65.1	
N=117	No	9.5	29.7	60.8	.007
NoGo	Yes	1.8	0.0	98.2	
N=119	No	0.0	0.0	100.0	.040

IX. Conclusions

The majority of the respondents favor geothermal development in Lake County. There is a pronounced tendency among our respondents to be either "for it" or "against it": i.e., they tend to have either a high or low opinion of geothermal development in all respects, which indicates that once they have made up their minds about it, this conviction tends to bias their perceptions from then on. We did, however, find a significant number of respondents who are undecided about the prospect.

Although this polarized pattern of response renders casual analysis hazardous, the data indicate that perception of environmental impacts and expectation of economic benefits are the main independent variables which determine attitudes toward geothermal development. This conclusion is reinforced by the fact that the county is poor and that its present economy and general attractiveness depend strongly upon the preservation of the county's natural environment.

As geothermal development proceeds within the county, the perceptions of environmental impacts and economic benefits by its residents will change, the directions of the shifts hopefully being determined by what actually occurs. However, it is quite likely that, for a given combination of impact perceptions and economic expectations, the distribution of future opinions on geothermal issues will fall into patterns similar to subgroups identified in this survey. In Figure 6 we present selected data concerning the distribution of opinions of the four impact perception/economic expectation groups, which include over 90% of the respondents. Almost all of those who perceive no negative environmental impacts and expect economic benefits favor development and would not leave the county because of it. Nearly three-fourths of them would lease their land for geothermal development. That group which is uncertain about the environmental

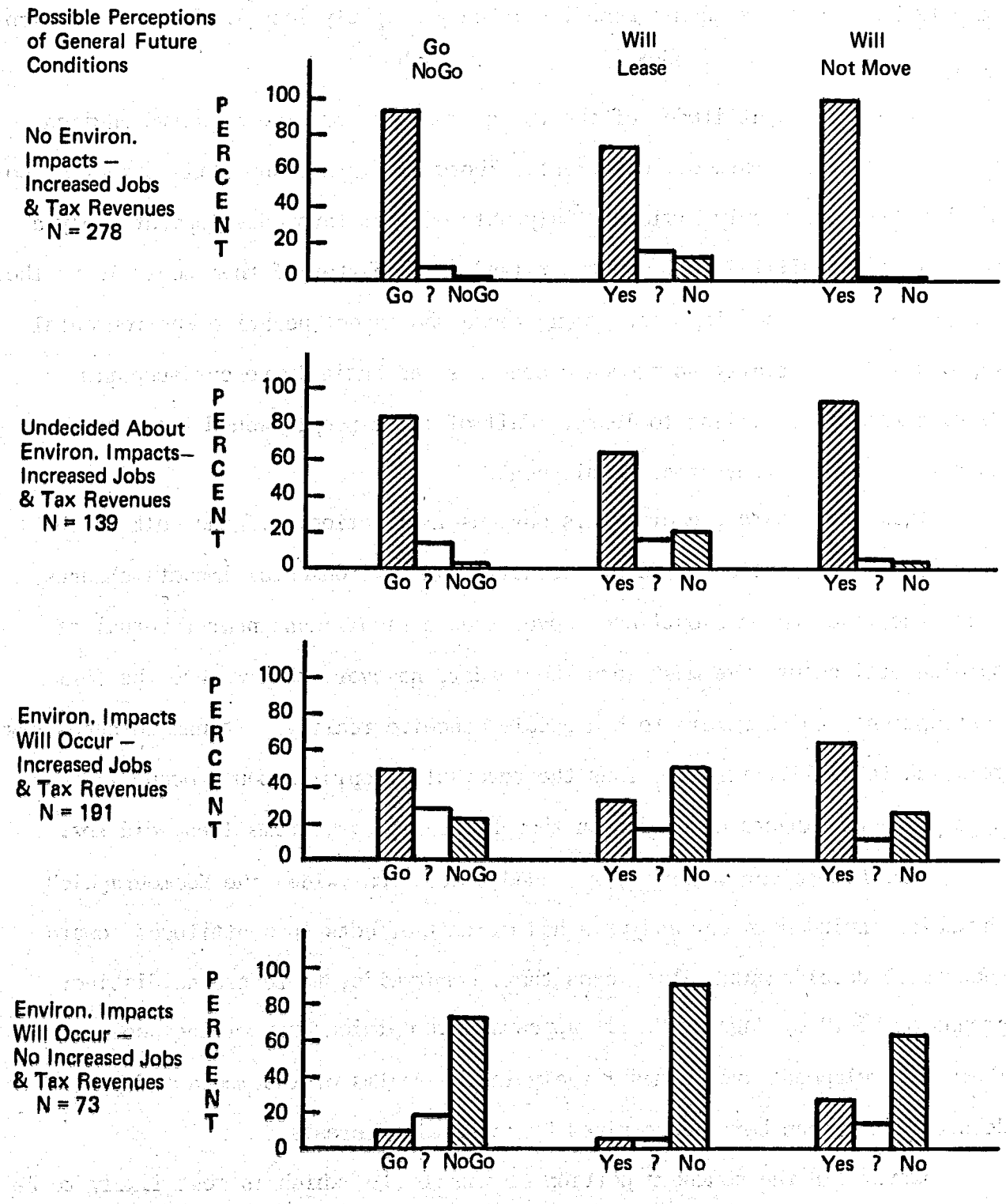


Figure 6. Possibilities of Future Public Opinion as Functions of Changes in the Perception of Economic and Environmental Impacts.

impacts but expects economic benefits is only slightly less in favor of development.

However, the attitudes of the two groups who perceive negative environmental impacts are markedly different. Those among them who still expect economic benefits are deeply divided. Only half of them favor development, only a third would be willing to lease their land, and quarter of them would leave the county because of development. Among those who expect negative environmental impacts and essentially no economic benefits, essentially no one supports development or is willing to lease. Half of these people would leave the county because of geothermal development.

From these data, we draw this obvious implication: if the bulk of the population's perception of future economic and environmental impacts changes along the lines we have outlined above, then a significant near-reversal of opinion will occur. We must warn the reader, however, that we use the term "perception," which refers to how people conceive reality. It has no necessary relation to reality itself. Thus the reversal of opinion could occur if the perception of impacts changed even though the impacts, themselves, did not.

Somewhat to our surprise, we found that, countywide, the "demographic" variables included in our analysis had minimal effects upon attitudes toward geothermal development. This means that, countywide, there are no distinct groups of "for" or "against". It appears that opinions concerning geothermal development are formed largely in the realms of the media and public debate rather than being determined by personal interests.

However, in the southern portion of the county, which is most likely to be directly affected by geothermal development, demographic variables do seem to have some effect. We have traced this effect through our discussions of general support, perception of environmental impacts, and willingness to lease for

development. A general (and very tentative) picture emerges concerning the southern respondents. Besides the obvious interest group of those whose land is under geothermal lease, there appears to be a larger pro-geothermal group whose opinions seem to be determined largely by the possibility of increased job opportunities, and tax revenues which they value highly. These people are likely to have lived in the county longer than the average. Opposing them is a group of relative newcomers to the county who probably came largely because of its natural environment and who tend to own the mineral rights to their land (probably "country places"), which they absolutely refuse to lease for development.

Finally, a large majority of the respondents as a whole, and nearly as large a majority of the most pro-geothermal group which we have been able to identify, favor close regulation of geothermal development. It appears that, at least in Lake County, the much advertised "backlash" against environmental concerns and protection is nearly nonexistent.

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Appendix A. Technical Appendix

Due to typographical errors and poor wording, the interpretation of a few questions must be qualified.

Question 18, land parcel size, was rendered confusing by typographical errors. However, the question was salvaged by combining the responses into two categories: less than ten acres, and greater than ten acres.

Question 13, the geographical location of the respondent, failed to elicit the proper (name of town) response. However, the responses were salvaged by using the county zip codes and classifying each respondent according to either a proper (name of city or town) answer, or the post-marked zip code on the back of the return mailer. By this method, it was possible to identify the place of residence of 95.6% of our respondents.

In question 20, the multiple-response recreation question, "Swimming and/or wading in streams or lakes" was inadvertently divided into two separate possible responses. The first one, "swimming," was used in the analysis to refer to swimming in natural water bodies, as opposed to artificial swimming pools.

Question 1, economic expansion of the county, did not contain any specific reference to geothermal development. It could be argued that a positive response to it does not necessarily indicate support for geothermal development, thus questioning its inclusion as a component in the Go-No Go index. However, we feel that because of the context of a geothermal survey in which this question appeared, it was very likely to have been interpreted by most of the respondents as relating largely or solely to geothermal development. A respondent who did not make this inference and thus answered question 1 positively, even though he opposed geothermal development, would still be a "No Go" because of the averaging process involved in calculating his response to the Go-No Go Index.

Question 2 should, perhaps, have been split into two separate questions, one about jobs and another about tax revenues. The responses to question 2 must be interpreted as being compromises between possibly conflicting attitudes or perceptions about the economic impact of geothermal development.

Question 3 is ambiguous and a number of interpretations are possible. We found no reasonable way of dealing with this ambiguity ex post facto.

The positive responses to question 9 may have been reduced somewhat if respondents felt they must answer negatively if they own no land. The question was meant to elicit responses to the willingness to lease if one owned land, irrespective of whether the person does, in fact, own land. Other data indicate that it was interpreted by our respondents in this manner. (See Section VIII.)

We note that the mineral rights question, 17, is somewhat ambiguous as some whose land is under geothermal lease might answer that the mineral rights to it are thus owned by "Others".

Question 23 appeared with only three possible responses. It might have been more interesting to have had five possible responses to allow a greater spread of opinions. This would have lent more significance to the resulting distribution.

Due to the fact that all twelve attitude questions were phrased in a "positive" sense, and the fact that one-third of the respondents were unsure if any environmental impacts would in fact occur, it could be argued that many of these respondents were persuaded by the phrasing because of their limited understanding of the nature of geothermal development. To the extent that this is true, the data probably overestimates to a degree, the actual support given geothermal development in the county. The fact that bias may have a strong effect has been discussed.

Finally, all of the first 12 questions could have been answered in differing ways, depending upon inferred but unspecified assumptions held in the minds of the respondents. For example, one could answer question 6 positively, believing that if proper control technology is developed and implementated, odor impacts will not be a problem. Or, one could feel the same except for not expecting such technology to be installed, and hence answer negatively. It is difficult to come to a definite conclusion from just a surface interpretation of responses. We have attempted to uncover some of the conditions and qualifications which influence the responses. However, there is no way to compensate fully for misreadings, misinterpretations, or inconsistent responses.

The 2500-person initial sample was selected from the county list of registered voters which was the best population list easily obtainable. The sample was randomized by selecting every third page from the voter list. Then, of those pages selected, every other one was turned over to allow the use of those voters listed on the back. Most duplicate addresses were removed to avoid over-representation of any one household. All precincts within the county were included.

The averaging process which we employed to calculate the "responses" to the two composite Indices (Go-No Go and Environmental Impacts) was as follows. We averaged the numerical responses (1 to 5) to the constituent questions, which resulted in a rational number (in general not an integer) such that $1 \leq n \leq 5$. This range was then split up in five subranges: 1 to 1 4/5, 1 4/5 to 2 3/5, 2 3/5 to 3 2/5, 3 2/5 to 4 1/5, and 4 1/5 to 5. The raw averaged responses were then set to an integer from 1 to 5, depending on which of these intervals they fell into. These integer values were then employed in all further calculations. We note that this particular assignment to intervals tends to accentuate the extreme. We felt that this was necessary since, of course,

the effect of averaging itself has the opposite effect. Only those respondents who answered all three component questions of each Index were included in that Index. Those who had not answered one or more of the component questions were considered to have "not answered" the Index.

Likewise, in the construction of any table, only those respondents who answered all questions of that table were included. Because of their form, the questions regarding recreational preferences and reasons for living in Lake County were considered to have been answered by all respondents.

The correlation (or "R") coefficients which appear in various places are statistical measures of the degree of correlation between questions. The value of a correlation coefficient may fall anywhere between -1 and 1. A value close to zero indicates a weak (or no) correlation between responses to the two given questions. A value near either 1 or -1 indicates a very strong correlation. The sign indicates the "direction" of the correlation. In most cases we have backed up the correlation coefficients with partial percentage figures or comments in order to minimize possible confusion regarding their meaning. It is evident that in some cases a smaller percentage shift may be associated with a larger correlation coefficient and vice-versa. This is because a percentage is simply one number quoted from a full table, while the correlation factor is calculated from the full table. Also, all correlations were calculated by using the original five responses to each of the first twelve questions, while the quoted percentages often refer to aggregated responses as discussed in Section II.

Appendix B. Demographic Statistics

A. Aggregate County Statistics

Lake County is a typical rural, sparsely populated county. It's economic base, largely devoid of industry, is based mainly upon recreation and agriculture. It has become known as a retirement county where natural environment and recreation seem to be prime attractors. The data from the survey seemed to support this general view of the county.

Table 1 (in section II) shows the aggregate county average statistics for the demographic variables of the survey. The respondent's geographical location in the county is shown in question 13. The area of greatest actual and potential geothermal development in the county, the southern section, contains the fewest people.

Question 15 shows, as expected, that nearly all respondents were year-round residents. Questions 16, 17, and 18 show the breakdowns for different types of property ownership: home, mineral rights, and land. As expected, most people were home owners. Yet only one-half knew that they owned their own mineral rights, and a sizeable percentage (27%) did not know whether they did or did not own mineral rights. Two-thirds owned less than ten acres of land.

The knowledge of mineral ownership is moderately related to parcel size (see Table 14). Large land owners were more likely to know they owned their own minerals; but still, 31% of them either did not know or felt the question of mineral rights was not applicable to their large land parcels. Geographic location had little influence on mineral ownership except in the southern county, where fewer respondents did not know and more owned their own minerals than the county average. The eastern county respondents were less sure of their mineral status. The size of land parcels bears no relationship to general geographical area.

Table 14

Various Relationships of Mineral Ownership
Land Ownership, Employment, and
Geographic Location

		(17.) Mineral Rights Owned:				
		By Self	By Others	Don't Know	Not Applicable	
18.	Own < 10 Acres	51.1	4.6	32.1	12.2	N=663
	Own > 10 Acres	63.8	4.9	17.9	13.4	
13.	Live in:					
	Southern Co.	63.1	4.3	19.1	13.5	N=698
	Northwest Co.	47.8	7.1	27.0	18.1	
	Eastern Co.	51.7	3.4	34.2	10.7	

		(13.) Geographic Location			
		Southern County	Northwest County	Eastern County	
18.	Own < 10 Acres	60.4	65.0	62.6	N=652
	Own > 10 Acres	39.6	35.0	37.4	
19.	Employed	5.7	50.2	50.6	
	Retired	44.9	45.2	44.8	N=737
	Other	3.4	4.6	4.5	

Question 19 indicates the employment and retirement percentages of the sample. 44.4% of the respondents are retired, a figure somewhat low when compared with the 53.5% retired among county residents 16 years and older recorded by the 1970 census. The fractions of employed and retired do not vary significantly among geographical areas.

Four recreational activities are popular with over one-half of the population (see Table 1). Relaxing and socializing seems to be the most popular activity, closely followed by fishing, observing nature, and boating.

When the respondents are broken into the two major groups, employed and retired, it is seen that their separate recreation patterns are essentially the same (Table 15). Those who are employed enjoy each activity somewhat more than the retirees, except for relaxing and socializing(See Fig. 7).

Overall, the natural environment of Lake County seems to be the most important reason for living in the county. As expected, employment opportunities are only moderately important. Apparently, fewer than 10% of the sample are native born. When the sample is again split into the employed/retired groups, significant differences become evident (see Table 15). Of course, retirement is the prime reason (84%) for retirees to live in the county. Yet for the employed, the natural environment is a more important factor than employment opportunities. Furthermore, of those people who do work, only 25% also feel retirement potential is an additional factor for their residence. This could indicate that many of those now employed in the county do not plan to retire in the county, or are too young to care about retirement.

The decline of retirement attractiveness theory was checked by controlling for length of residence (question 14). It was found that of the new residents (0-5 years) who are employed, 36% also indicate retirement is an additional factor for their living in the county. This figure compares to 18.7% for long-time (over 15 years) residents. These figures contradict the possibility that Lake County is "losing its appeal" as a retirement place for those now employed there. This conclusion is further supported by similar figures for retired respondents.

B. The County in Transition

A survey gives only a static picture of a population at a specific moment in time. To see trends over time one needs to compare a number of identical surveys taken over a period of years. However, one can indirectly obtain a time

Table 15

Recreational Patterns and Reasons for

Residence of Employed and Retired

(% Responding "Yes")

20. Type of Recreation	Employed N=392 (50.7%)	Retired N=343 (44.9%)	Total N=773
Relax & Socialize	72.7	79.6	75.5
Fish	74.2	71.7	71.8
Observe Nature	67.1	61.8	65.3
Boat	61.5	53.9	58.1
Swim	59.2	37.9	49.7
Camp	53.6	35.0	45.0
Hike	47.7	35.9	42.9
Hunt	44.9	28.0	36.5
Swim in pools	39.0	22.4	32.1
Golf	19.6	15.2	17.3

21. Reason for Living in County	Employed	Retired	Total
Natural Environment	61.7	58.9	60.2
Retirement	24.5	84.3	50.5
Recreation	46.2	46.1	45.4
Family & Friends	38.0	27.4	34.0
Employment	54.8	7.6	32.1
Health	24.2	36.7	30.0
Housing	7.1	15.2	11.3
Born Here	11.2	5.0	8.4

series picture of the Lake County respondents by using question 14 (Length of residence). This of course assumes that the reasons one now states for living in Lake County have not changed and are, in fact, the same ones as those which originally attracted him.

So by using question 14 as if it had produced three separate samples taken over the years, one can see that different factors have been of primary force in

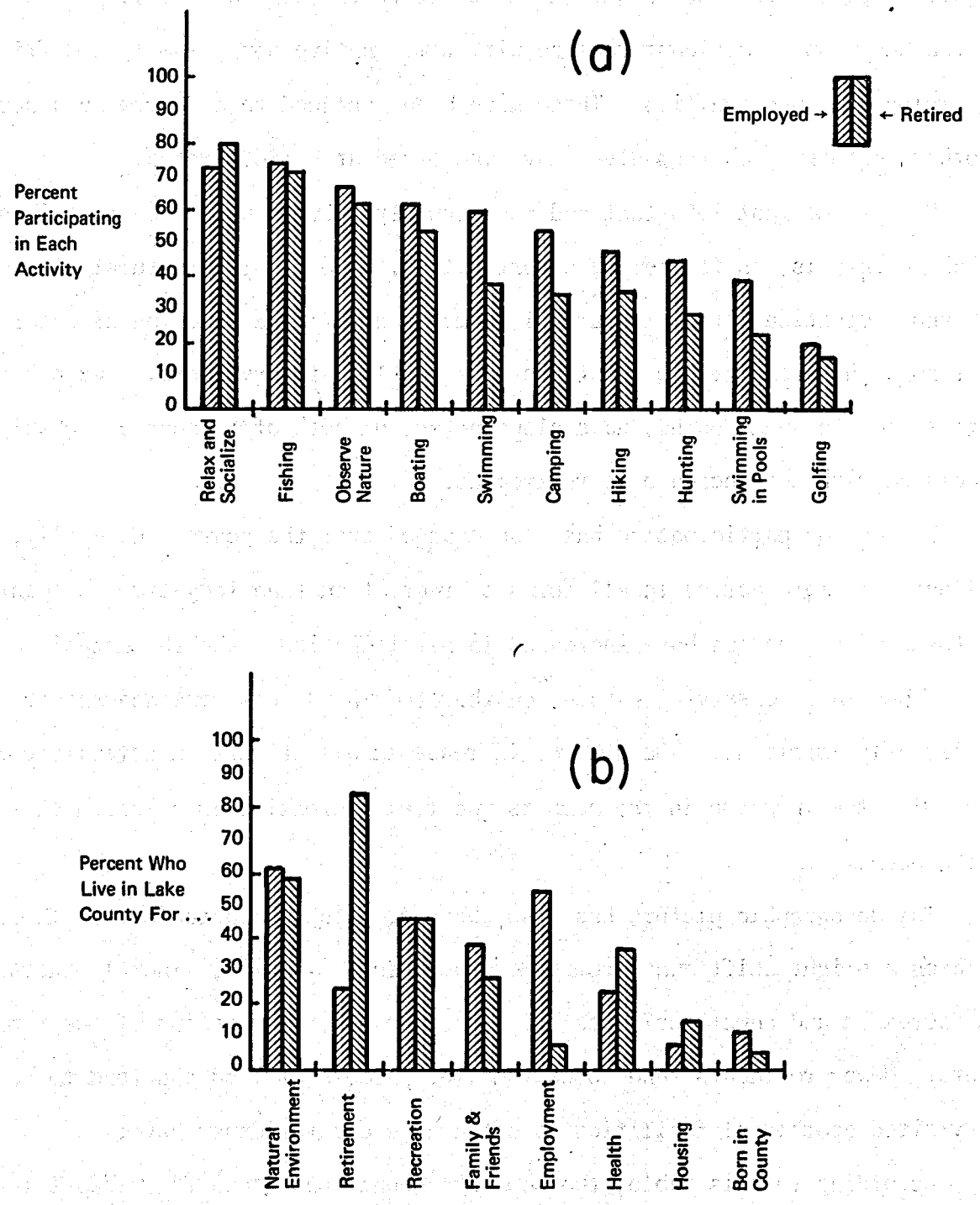

Figure 7. (a) Recreational Activities of Employed and Retired
(b) Reasons for Living in Lake County for Employed and Retired.

attracting people to Lake County in different years (see Table 16). Three of the reasons show significant decline with time: native born, family and friends, and employment opportunities. These have been replaced to a degree by a number of other factors which themselves have increased at various rates.

By far the most important and most rapidly increasing reason for living in Lake County is its retirement opportunities. The county's natural environment and recreation activities are also important. The attraction of natural environment has remained quite stable over the last twenty years. Two other factors, health and housing, have also increased; both of these are probably associated with the increase in retirement.

Recreation participation has also changed over the years. Generally, newer residents are more active in all forms of recreation than long-time residents. All forms of recreation have increased in participation, with the notable exception of hunting. Observing nature, on the other hand, has remained rather consistently important. The general increase in all recreation activity correlates with the increase in the numbers who feel recreation is a reason they live in the county.

The demographic picture has also changed, as shown in table 16. There has been a slight shift away from home ownership. Likewise, mineral ownership has decreased and newer residents are less sure about the status of their mineral rights. Newer residents tend to own smaller parcels of land and tend to have not visited geothermal facilities as often as older residents have.

According to this table, the southern county has grown the slowest in population, while the eastern county has grown the fastest, relative to the county as a whole. The changing employment/retirement ratio has shown a slight shift towards retirees among newcomers to the county. This corresponds to the marked increase in retirement as the prime reason for living in the county.

Table 16
Demographic Trends in Lake County
(% Responding "yes")

		(14.) Length of Residency in Lake County		
21.	Reasons for Living In County	N=272 0-5 years	N=223 6-15 years	N=288 >15 years
	Born Here	0.0	1.3	21.5
	Family & Friends	16.9	24.7	57.3
	Employment	20.6	33.2	41.0
	Retirement	62.1	48.9	41.0
	Natural Environment	59.6	62.8	58.3
	Recreation	47.8	51.1	37.8
	Health	33.1	31.8	26.7
	Housing	13.6	11.7	9.4
20.	Recreational Activities			
	Relax & Socialize	79.0	76.2	72.9
	Fish	78.3	69.1	68.1
	Observe Nature	66.5	65.5	64.6
	Boat	66.9	62.8	46.5
	Swim	55.1	49.3	44.1
	Camp	45.6	41.7	46.9
	Hike	47.4	40.8	40.3
	Hunt	32.4	35.0	41.3
	Swim in pools	33.8	32.3	29.9
	Golf	20.6	15.7	15.3
16.	home owner	85.2	87.9	90.9
17.	owns own mineral rights	45.6	46.0	61.6
	Don't know mineral status	32.5	29.6	20.1
18.	owns < 10 acres	72.6	65.5	53.1
19.	Employed	47.6	54.3	50.7
	Retired	46.8	41.6	44.4
22.	Have visited Geo. Facility	36.2	43.1	48.4
13.	Geographic Location:			
	Southern County	30.9	33.6	35.6
	Northwest County	34.2	26.7	39.2
	Eastern County	40.3	30.2	29.6