PUBLIC OPINION AND LOS ANGELES SMOG
WILLINGNESS TO TRADE HIGHER ENERGY PRICES FOR CLEANER AIR

BY

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Presented here are results of a public opinion poll which asked Los Angeles area residents whether they would be for or against an air pollution control program which would double visibility at a cost of $10 per family per month. Although most respondents considered inflation to be a greater nuisance than air pollution, residents surveyed favored the pollution control program by a 3 to 1 margin.
INTRODUCTION

In this survey, we present consumers with a feasible improvement in the quality of their environment and attempt to determine whether or not they feel it is worth the cost. We ask residents of the South Coast Air Basin which surrounds Los Angeles to consider a tradeoff between pollution and price increases. We present them with a pollution abatement program which would double visibility at a cost of ten dollars per month to an average family.

Nationwide polls suggest that most people would be unwilling to accept anti-pollution regulations which increased a family's total annual expenses by $120 per year. For example, a nationwide, September 1969 survey conducted by Louis Harris and Associates for the National Wildlife Federation found that only 32 percent of the population were willing to accept a $100 per year increase in total family expenses "to get real clean-up" in their "natural environment." There are several reasons, however, to suspect that people who currently breathe Los Angeles smog would pay more than the amounts suggested by previous studies.

First, air pollution in the Los Angeles Basin is far worse than it is nationwide.

Second, although the consumer price index has almost doubled since 1969, money incomes have risen even faster than the rate of inflation.
Third, concern for equity may greatly influence the respondent's willingness to pay for clean air, a public good. A 1971 nationwide Harris poll found that 59 percent of the population were willing to pay "$15 a year more in taxes to finance a federal program to control air pollution." However, a 1971 Roper Poll found that "... to eliminate pollution caused by automobile exhausts," 68 percent of the population would be "willing to pay 10 percent more for gasoline," and "... to eliminate pollution caused by power plants," 64 percent would be "willing to pay 10 percent more for electricity."

Based on estimates for consumption per household of gasoline and electricity we concluded that these two ten percent increases would have cost an average Los Angeles family about $70 per year in 1971 dollars. Although this discrepancy may be a result of the respondent's failure to grasp the implications of a 10 percent increase, attitudes toward taxes may also have had a significant effect. If people believe that taxes are too high and that government wastes their money, they may understate their willingness to pay for improvements in air quality when asked to accept a tax increase in return for cleaner air. That consumers have preferences concerning the way in which money to pay for pollution control is collected is illustrated in Table 1, which lists the results of a 1971 nationwide poll conducted by the Opinion Research Corporation.
TABLE 1
Results of a 1971 Nationwide Poll
Conducted by Opinion Research Corporation

"HOW DO YOU THINK GOVERNMENT SHOULD RAISE THE MONEY IT NEEDS TO HELP CLEAN UP POLLUTION?"

1971: January 27-February 20

<table>
<thead>
<tr>
<th>Option</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge people and industries a fee based on the amount of pollution</td>
<td>44</td>
</tr>
<tr>
<td>each one is causing</td>
<td></td>
</tr>
<tr>
<td>Add a special tax on the prices of products that can cause pollution</td>
<td>28</td>
</tr>
<tr>
<td>such as autos, detergents, and nonreturnable bottles</td>
<td></td>
</tr>
<tr>
<td>Increase general taxes, such as sales and income taxes</td>
<td>8</td>
</tr>
<tr>
<td>Increase taxes on property, such as homes and businesses</td>
<td>2</td>
</tr>
<tr>
<td>Other answers</td>
<td>12</td>
</tr>
<tr>
<td>No opinion</td>
<td>12</td>
</tr>
</tbody>
</table>

Reference: Erskine 1972a
A recent Resources for the Future report (Mitchell, 1978) suggests that 62 percent of the population thought it was better to pay higher prices for goods and services in order to protect the environment, compared to the 18 percent of those surveyed who preferred lower prices and more pollution.

Two conclusions which can be drawn from previous polls are: people are willing to pay for pollution control, but the amount which they are willing to spend depends upon the method of payment.

QUESTIONNAIRE

Many people may not have given the cost of pollution abatement careful consideration. For this reason, we asked them two questions which encouraged them to think about this issue.

The first question asked,

"Which has bothered you more during the last year: inflation or air pollution?"

This encouraged the respondent to weight the loss in his or her welfare caused by higher prices against the loss in welfare caused by smog.

In the second question, steps were taken to encourage respondents to separate their preferences for various types of air quality improvement. We wished to reduce the likelihood that people would automatically say yes to a question concerning visibility improvement because they believed that the same thing that makes the air look dirty also makes them sick.
That second question addressed preferences over different types of benefits from cleaner air:

"If you had to choose, which would you like to have most: a doubling of visibility, an elimination of air pollution-caused eye irritation, or a 50 percent decrease in the chance that a nonsmoker will die of lung disease...Again, the benefits are: more visibility, less eye irritation, or less lung disease."

We are not certain that such decreases in health impact are feasible simply because the health effects of air pollution are not understood precisely at present. The visibility improvement offered could be obtained by the approach outlined by Cass (1978). The survey's second question was intended merely to encourage respondents to consider the relative values of three different benefits from air pollution abatement. The purpose of this question is to alert respondents to the fact that a program which provides a 50 percent decrease in the visibility problem may not produce a 50 percent decrease in air pollution-caused health effects.

In Question 3 respondents were told,

"To improve visibility, government officials are considering strict limits on air pollution from oil refineries and electric power plants. Although these regulations will cut industry profits, part of the cost will be passed on to consumers. Air pollution scientists predict that tight controls on emissions from these industries will double visibility. Some days will still be clearer than others, but on any given day, you would see twice as far. Assume that these regulations encourage industry to use the cheapest methods available to reduce pollution, but will still add 10 percent to gasoline prices and electric rates. The cost of doubling visibility to an average family would be 10 dollars per month."
Then they were asked,

"Would you be for or against these regulations?"

As can be computed from Table C2 and Appendix B, $10 per month per household amounts to over $450,000,000 per year in revenue from the 3.8 million households in the geographic region surveyed. An air pollution control strategy which would cut particulate sulfate levels in the Los Angeles basin to about half of their 1973 levels at a cost of $100,000,000 per year has recently been proposed (but not adopted in its entirety) by the South Coast Air Quality Management District (1978). Studies by Cass (1978) indicate that the visibility improvement expected in the Los Angeles area from a 50% reduction in average sulfate levels would accomplish about half of the visibility improvement proposed to our respondents. It thus seems reasonable to expect that for $450,000,000 per year, a full doubling of visual range in Los Angeles could indeed be obtained.

Considerable effort was devoted to satisfying the respondent's desire for equity. We felt it was essential to convince the respondent that everyone would bear a portion of the cost and that there would be no opportunity to free-ride. Thus, we avoided the phrase, "How much would you be willing to pay...?" As Table 1 suggests, many people feel that industry should bear a portion of pollution abatement costs. Therefore, we told respondents that new pollution control regulations will both cut profits in the gasoline and electric power industries and increase the price of those products to consumers. This is a perfectly credible statement. Evidence to support it can be
found both in the predictions of economic theory and in the annual reports of oil companies and electric power firms subject to pollution controls. In reality, other industries in addition to electric utilities and petroleum refiners would be affected by a major pollution abatement project in the Los Angeles region, but the prospect remains that the public would pay through increased consumer prices to about the extent suggested in this question.

SAMPLING METHOD

We chose to use telephone rather than personal interviews. Although many books on survey sampling advise against using the telephone, several studies have found little difference between the results of personal interviews and the results of random-digit dialed surveys. Since the area to be surveyed, the South Coast Air Basin which surrounds Los Angeles, is quite large, interviewers would frequently have to drive for more than an hour to reach the neighborhood in which they would be working. Thus, use of the phone achieves a considerable reduction in cost with little loss in accuracy.

In California, there is little difference in the socioeconomic characteristics of people with published telephone numbers and the socioeconomic characteristics of the total population. We could establish no reason why, socioeconomic variables being equal, someone with a listed phone number would be more likely to favor air pollution controls than someone without a listed phone number. Therefore, our sample was chosen at random from those residents of the South Coast
Air Basin who have a listed phone number. However, since more than a third of the residential phone numbers in Los Angeles are unpublished, the jump from random digit dialing to random selection from listed numbers requires some leap of faith on our part.

With the exception of five neighborhoods in southern Los Angeles County, all of the South Coast Air Basin can be surveyed within the bounds of 12 non-overlapping telephone directories. The oldest of these twelve directories was published in April 1978. Sixty-one telephone numbers were selected by the procedure described in Appendix C. Since 3.5 percent of the Basin's population lives in the neighborhoods omitted by our 12 directory span, it would have been appropriate to select two phone numbers from these neighborhoods. This was not done. For a larger sample, however, it would be worth the effort to draw phone numbers from these neighborhoods.

INTERVIEWING TECHNIQUE

Several studies indicate that there are subtle ways in which the interviewer can bias the results of a survey. According to these studies, a friendly interview is less likely to yield accurate responses than a businesslike interview. Barath and Cannell (1976) found that the interviewer's voice intonation could bias responses to survey questions. They compared the results of a survey in which the interviewer ended yes-no questions with ascending tones to the results of the same survey except the interviewer ended the questions
with descending tones. They found that a dropping voice resulted in a statistically significant (0.05 level) decrease in the number of positive responses. Keeping the interview short, task-oriented and unbiased was an important consideration during the execution of our survey.

When the respondent answered the phone, the interviewer gave his name, told the respondent he was with a Caltech public opinion research group, and asked for five minutes to ask the respondent some questions about air pollution. If the respondent said, "I don't have any opinions about air pollution." then the interviewer said, "This survey also concerns higher gasoline prices, do you have any opinions about that?" Interviews were polite and businesslike, and in each case care was taken to read the questions as they normally would be asked during the course of a less structured conversation.

RESPONSE RATE

Interviews were conducted between 6 and 9 p.m. on Monday, May 21 through Thursday, May 24, 1979. If necessary, a total of four attempts was made to reach each number unless it was not in service. There were 61 residences in the original sample. Twelve of these were not reached. Of the 49 people who were reached, 15 refused to be interviewed -- a refusal rate of 31 percent. The response rate for numbers reached was 69 percent and the overall response rate was 56 percent.
RESULTS

Tables 2, 3, and 4 present the results of the survey. Most respondents said that inflation bothered them more than air pollution. Most said that they considered lung disease more important than eye irritation or visibility. Nevertheless, the answers to Question 3 (Table 4) indicate strong support for new air pollution control regulations which would achieve a doubling of visibility at a cost of ten dollars per family per month. If those who were not sure how to answer Question 3 are eliminated, a sample of 30 remains. This sample is large enough to permit the assumption that the error is normally distributed.

Let \( y \) = the number who said, "for" to Question 3: \( y = 23 \)

Let \( n \) = the total relevant sample size: \( n = 30 \)

The best unbiased estimator of \( p \); the probability of an affirmative response to Question 3 from someone who has a listed phone number, who answers the phone between 6 and 9 p.m., who agrees to an interview, and is sure of his or her response, is \( p = y/n \).

\[
p = 0.77
\]

A 95 percent confidence interval for \( p \) is given by:

\[
(0.77 - 2(0.77(1 - 0.77)/30)^{1/2}, 0.77 + 2(0.77(1 - 0.77)/30)^{1/2})
\]

\[= (0.62, 0.92) = (62\%, 92\%).\]

With 95 percent confidence, between 62 percent and 92 percent of those in our survey population who had opinions favored the visibility improvement program. With 99 percent confidence, the percentage "for" is between 59 and 95 percent.
TABLE 2

Question 1: Which do you think has bothered you more during the last year: inflation or air pollution?

<table>
<thead>
<tr>
<th></th>
<th>Inflation</th>
<th>Air Pollution</th>
<th>Neither</th>
<th>Both</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>77%</td>
<td>15%</td>
<td>8%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>(10)</td>
<td>(2)</td>
<td>(1)</td>
<td>(0)</td>
<td>(0)</td>
</tr>
<tr>
<td>Female</td>
<td>81%</td>
<td>10%</td>
<td>0%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>(17)</td>
<td>(2)</td>
<td>(0)</td>
<td>(2)</td>
<td>(0)</td>
</tr>
<tr>
<td>Total</td>
<td>79%</td>
<td>12%</td>
<td>3%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>(27)</td>
<td>(4)</td>
<td>(1)</td>
<td>(2)</td>
<td>(0)</td>
</tr>
</tbody>
</table>

Actual numbers in ( ).
Question 2: The next question concerns benefits from clean air. If you had to choose, which would you like to have most: a doubling of visibility, an elimination of air pollution-caused eye irritation, or a 50 percent decrease in the chance that a nonsmoker will die of lung disease.... Again, the benefits are: more visibility, less eye irritation, or less lung disease.

<table>
<thead>
<tr>
<th></th>
<th>Visibility</th>
<th>Eye Irritation</th>
<th>Lung Disease</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>8%</td>
<td>23%</td>
<td>62%</td>
<td>8%</td>
</tr>
<tr>
<td></td>
<td>(1)</td>
<td>(3)</td>
<td>(8)</td>
<td>(1)</td>
</tr>
<tr>
<td>Female</td>
<td>10%</td>
<td>14%</td>
<td>62%</td>
<td>14%</td>
</tr>
<tr>
<td></td>
<td>(2)</td>
<td>(3)</td>
<td>(13)</td>
<td>(3)</td>
</tr>
<tr>
<td>Total</td>
<td>9%</td>
<td>18%</td>
<td>62%</td>
<td>12%</td>
</tr>
<tr>
<td></td>
<td>(3)</td>
<td>(6)</td>
<td>(21)</td>
<td>(4)</td>
</tr>
</tbody>
</table>

Actual numbers in ( ).
Question 3: To improve visibility, government officials are considering strict limits on air pollution from oil refineries and electric power plants. Although these regulations will cut industry profits, part of the cost will be passed on to consumers. Air pollution scientists predict that tight controls on emissions from these industries will double visibility. Some days will still be clearer than others, but on any given day, you would see twice as far. Assume that these regulations encourage industry to use the cheapest methods available to reduce pollution, but will still add 10 percent to gasoline prices and electric rates. The cost of doubling visibility to an average family would be 10 dollars per month. Would you be for or against these regulations?

<table>
<thead>
<tr>
<th></th>
<th>For</th>
<th>Against</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>62%</td>
<td>23%</td>
<td>15%</td>
</tr>
<tr>
<td>(8)</td>
<td>(3)</td>
<td>(2)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>71%</td>
<td>29%</td>
<td>0%</td>
</tr>
<tr>
<td>(15)</td>
<td>(6)</td>
<td>(0)</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>68%</td>
<td>26%</td>
<td>6%</td>
</tr>
<tr>
<td>(23)</td>
<td>(9)</td>
<td>(2)</td>
<td></td>
</tr>
</tbody>
</table>

Actual numbers in ( ).
NOTES


2. U.S. Department of Commerce, Survey of Current Business, November 1969, p. S-7 and March 1979, p. S-8. The Consumer Price Index in September 1969 was 129.3 (1957-1959 = 100) and the CPI in 1967 was 116.3 (1957-1959 = 100). Thus, the September 1969 CPI was 111.2 (1967 = 100). The February 1979 CPI was 207.1 (1967 = 100). The increase in the CPI from September 1969 to March 1979 was 86 percent.


4. Ibid., p. 135. See Appendix A for entire question.

5. U.S. Department of Commerce, Survey of Current Business, March 1971, pp. S-8 and S-3 and March 1979, pp. S-9 and S-35. This estimate was obtained by taking our estimates for current average family expenditures for electricity and for gasoline and adjusting them for lower 1971 prices. The price index for gas and electricity in February 1971 was 112.8 (1967 = 100). The price index for gas and electricity in 1979 was 186.0 (1967 = 100). Current average family expenditure for electricity was multiplied by 112.8/186.0 = 0.606 in order to recover our estimate in 1971 dollars.

Gasoline prices (less tax) were 24.1¢ per gallon in February 1971 and 70¢ in February 1979. Fourteen cents tax per gallon was assumed for both years. Current family expenditure for gasoline was multiplied by (24.1 + 14)/(70 + 14) = 0.454 in order to obtain an estimate in 1971 dollars. For estimates of average annual family expenditures for gasoline and for electricity, see Appendix B.

7. Doubling visibility is achieved by a 50 percent reduction in the light extinction by particles in the air.

8. See Klecka and Tuchfarber (1978), Rogers (1976), or Wiseman (1972).

9. See Rich (1977). We suspect that a large fraction of single women in Los Angeles have unlisted numbers. However, these women represent only 11 percent of the total adult population in Los Angeles County (1970 Census). Giving this group a lower probability of being selected for an interview should not change the results very much.


References Cited


Supporting References


The following is quoted from Hazel Erskine (1972a) "The Polls: Pollution and Its Costs," Public Opinion Quarterly, V. 36.

P. 133

HARRIS for WILDLIFE
You are already sharing in the costs brought to us all by air and water pollution. In order to solve our national problems of air and water pollution, the public may have to pay higher taxes and higher prices for some products. To get real clean-up in your natural environment, would you be willing to accept a per-year increase in your family's total expenses of $200/$100/$50/$20?

1969: July 10

<table>
<thead>
<tr>
<th>Increase</th>
<th>Willing</th>
<th>Unwilling</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>$200 increase</td>
<td>22%</td>
<td>65%</td>
<td>13%</td>
</tr>
<tr>
<td>$100 increase</td>
<td>32</td>
<td>56</td>
<td>12</td>
</tr>
<tr>
<td>$50 increase</td>
<td>42</td>
<td>47</td>
<td>11</td>
</tr>
<tr>
<td>$20 increase</td>
<td>55</td>
<td>35</td>
<td>10</td>
</tr>
</tbody>
</table>

By size of community:
- Cities:
  - $200 increase: 24, 62, 14
  - $20 increase: 54, 34, 12
- Suburbs:
  - $200 increase: 28, 64, 8
  - $20 increase: 66, 26, 8
- Towns:
  - $200 increase: 18, 66, 16
  - $20 increase: 47, 39, 14
- Rural:
  - $200 increase: 16, 70, 14
  - $20 increase: 50, 41, 9

By geographic region:
- East:
  - $200 increase: 22, 68, 10
  - $20 increase: 57, 33, 10
- Midwest:
  - $200 increase: 26, 64, 10
  - $20 increase: 65, 30, 5
ROPER
A good many products in one way or another are contributing to the pollution of our air and water—and it will probably cost quite a lot to develop methods to prevent the pollution effects. Would you be willing to pay 10% more for (each proposition below) or do you think the problem is not that serious?

<table>
<thead>
<tr>
<th>1971: October</th>
<th>Willing</th>
<th>Not Serious</th>
<th>Undecided</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Detergents if it turns out to be the only way to eliminate their pollution of water supplies?</strong></td>
<td>69%</td>
<td>17%</td>
<td>13%</td>
</tr>
<tr>
<td><strong>Gasoline if it turns out to be the only way to eliminate the pollution caused by automobile exhausts?</strong></td>
<td>68</td>
<td>16</td>
<td>15</td>
</tr>
<tr>
<td><strong>An automobile if it turns out to be the only way to eliminate the pollution caused by the exhausts?</strong></td>
<td>67</td>
<td>17</td>
<td>17</td>
</tr>
<tr>
<td><strong>Electricity if it turns out to be the only way to eliminate the pollution caused by power plants?</strong></td>
<td>64</td>
<td>22</td>
<td>14</td>
</tr>
<tr>
<td><strong>Magazines and newspapers if it turns out to be the only way to eliminate pollution caused by paper mills?</strong></td>
<td>60</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td><strong>Airplane tickets if it turns out to be the only way to eliminate pollution caused by their exhausts?</strong></td>
<td>59</td>
<td>18</td>
<td>22</td>
</tr>
</tbody>
</table>

HARRIS
Would you be willing to pay $15 a year more in taxes to finance a federal program to control air pollution?

<table>
<thead>
<tr>
<th>1967: July 24</th>
<th>Willing</th>
<th>Unwilling</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>44%</td>
<td>46%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>34</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>59</td>
<td>34</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>By size of community:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>44</td>
<td>47</td>
<td>9</td>
</tr>
<tr>
<td>1970</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suburbs:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>54</td>
<td>38</td>
<td>8</td>
</tr>
<tr>
<td>1970</td>
<td>63</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Towns:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>43</td>
<td>46</td>
<td>11</td>
</tr>
<tr>
<td>1970</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>32</td>
<td>53</td>
<td>15</td>
</tr>
<tr>
<td>1970</td>
<td>48</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*The words “or unwilling” were added in the 1971 question.*
APPENDIX B

The Estimated Cost of Gasoline and Electricity to an Average Household in the Los Angeles Area -- 1979

We estimated that an average family in the Los Angeles Basin spent $71 per month on gasoline and $23 per month on electricity. The sum of these two expenditures is $94 per month. Thus, a 10 percent increase in gasoline prices and electric rates would cost the average family about $9.40 per month. That value was rounded up to $10 per household per month in order to simplify the questionnaire.

GASOLINE

The gasoline cost estimate was obtained from statistics for a 50 x 50 mile square area laid over Los Angeles County (except a sparsely populated northern section) and Northern Orange County, as shown in Table B1.

ELECTRICITY

Southern California Edison Company serves much of the area surveyed. The company's 1978 residential revenue was $704,658,000 (source: 1978 Annual Report). Edison Company had about 2,600,000 residential customers in 1978 (source: phone call to company). Average monthly expenditures per household = \( \frac{704,658,000}{2,600,000} \times \frac{1}{12} \) = 23 dollars/month
TABLE B1

Estimation of Expenditures on Gasoline per Household per Month

<table>
<thead>
<tr>
<th>Measure</th>
<th>Quantity within 50x50 mile study area</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>total population (1974)*</td>
<td>8,139,000</td>
<td>Cass (1978)</td>
</tr>
<tr>
<td>persons per household</td>
<td>2.4</td>
<td>1970 Census (LA-Long Beach SMSA)</td>
</tr>
<tr>
<td>households (hh)</td>
<td>3,391,000</td>
<td>calculated</td>
</tr>
<tr>
<td>miles driven per day (1974)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>freeway</td>
<td>49,523,000 vmt/d</td>
<td>Cass (1978)</td>
</tr>
<tr>
<td>surface streets</td>
<td>79,375,800 vmt/d</td>
<td></td>
</tr>
<tr>
<td>total</td>
<td>128,898,800 vehicle miles traveled per day</td>
<td></td>
</tr>
<tr>
<td>fraction of miles driven by heavy trucks</td>
<td>7.8%</td>
<td>Cass (1978)</td>
</tr>
<tr>
<td>fraction of miles driven by cars and light trucks</td>
<td>92.2%</td>
<td>Cass (1978)</td>
</tr>
<tr>
<td>vehicle miles traveled per day by cars and light trucks (1974)</td>
<td>118,844,694</td>
<td>calculated</td>
</tr>
<tr>
<td>miles driven per day per household</td>
<td>35 vmt/d/hh</td>
<td>calculated</td>
</tr>
<tr>
<td>nationwide average automobile gas mileage (1973)</td>
<td>13.6 mpg</td>
<td>U.S. Environmental Protection Agency (1975)</td>
</tr>
<tr>
<td>gasoline consumption per month</td>
<td>79 gallons</td>
<td>calculated</td>
</tr>
<tr>
<td>gasoline price (February 1979)</td>
<td>$.90/gallon</td>
<td>assumed</td>
</tr>
<tr>
<td>avg. expenditures on gasoline per month per household**</td>
<td>$ 71/m/hh</td>
<td>calculated</td>
</tr>
</tbody>
</table>

Notes: *The 1970 population within the entire South Coast Air Basin which includes portions of Los Angeles, Orange, Riverside and San Bernardino Counties is estimated at 9,098,053 persons in Table C2 of Appendix C. The smaller 50x50 mile study area
defined by Cass (1978) was used in this gasoline consumption calculation because population and vehicle miles traveled in 1974 are both known more accurately within that zone.

**This is an upper limit to a true value experienced by the average household because some auto and light truck travel is conducted for business rather than household purposes.**
APPENDIX C
Random Telephone Number Selection

The phone books listed in Table Cl cover most of the South Coast Air Basin with negligible overlap (less than one percent of the numbers are listed in more than one book).

Phone numbers from these books were selected in the following manner: A computer generated random numbers between 1 and 7,448, the total number of white pages in the twelve phone books. The computer program rank ordered these numbers and then used them to select pages in the appropriate book according to break points given in Table Cl. For example, phone numbers in the Chino, Pomona, and Ontario phone book start on page 21. If one of the numbers chosen were 6,400 the computer program would select an appropriate phone book and page by subtracting the number of pages in the preceding seven books, 6,294, and then adding the page shift (20 in this case).

Next, the computer program assigned to each page number a random integer between 1 and 4, and a random integer between 0 and 260. These were column numbers and number of millimeters down the column. The print in each column in these phone books is 260 millimeters high. There are 123 lines per column. Thus each line is slightly over 2 millimeters high. All phone books except Los Angeles have four columns per page. Therefore, this selection system gave every line
TABLE C1

List of the Telephone Directories Used to Represent the South Coast Air Basin

<table>
<thead>
<tr>
<th>( X_1 )</th>
<th>Area</th>
<th>Threshold Value*</th>
<th>Page Shift**</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Northwestern</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>Western</td>
<td>1,039</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>Los Angeles (123 lines)</td>
<td>1,694</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>Pasadena (Northeastern)</td>
<td>2,860</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>South Bay Area (GTE)</td>
<td>3,828</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>Long Beach</td>
<td>4,402</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>Orange County, Central &amp; North</td>
<td>4,962</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>Chino, Pomona, &amp; Ontario</td>
<td>6,294</td>
<td>(add 20)</td>
</tr>
<tr>
<td>9</td>
<td>Bloomington, Fontana &amp; Rialto</td>
<td>6,658</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>Angeles Oaks, Redlands, and San Bernardino</td>
<td>6,949</td>
<td>(add 22)</td>
</tr>
<tr>
<td>11</td>
<td>Riverside</td>
<td>7,057</td>
<td>0</td>
</tr>
<tr>
<td>12</td>
<td>Edgemont &amp; Sun City</td>
<td>7,252</td>
<td>(add 22)</td>
</tr>
<tr>
<td></td>
<td>Total Pages</td>
<td>7,448</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Threshold Value indicates the number of the last page in the preceding directory if the white pages of all directories were placed in the order shown and then renumbered consecutively.

**Page shift indicates that telephone numbers do not begin on page one of the white pages in this book. Instead, telephone numbers begin on page (Page Shift + 1).
in every column (with the exception of the fifth column in the Los Angeles book), of every page, in every book identical probability of being chosen. Then an adjustment was made for the additional 5th column of names appearing in the Los Angeles directory. The number of page numbers selected from the Los Angeles book was divided by four. This fraction gave the number of additional random integers between 1 and 655 (the number of pages in the Los Angeles book) which must be generated to account for the 5th column of names on each page of that book. These new random numbers were ordered and used to select additional pages from the Los Angeles directory. A random number between 0 and 260 was assigned to each of the new page numbers in order to specify distance down the page, as before. That distance down the page was assigned to column five on the chosen page.

Either because they have two phones or because the subscriber has a long name, some households take two lines in the phone directory. They have twice the probability of being chosen by the above system. To correct this, every second two-line household encountered was thrown out. Phone numbers of businesses, government agencies, churches, professional offices, etc., were also thrown out. About one in every three vectors of random page, column, and distance down the page numbers had to be thrown out. It takes about 100 vectors of random numbers to select 67 residential phone numbers by the method outlined above.

Every residence with a listed phone number in the area covered by the twelve books had an equal probability of being selected.
The neighborhoods not covered by the twelve books are Downey, Norwalk, Lynwood, Carson, and Wilmington. The relevant population numbers from the 1970 census are listed in Table C2. The total population in these five areas is 3.6 percent of the total population of the area being studied. So, the number of phone numbers from these five neighborhoods needed to round out the sample is four percent of the total numbers selected from the twelve-book span. A random procedure, similar to the one described above, could have been used to select numbers from the South Bay (Pacific Telephone) directory, with numbers accessed from that book which do not fall into these five neighborhoods thrown out. Instead, the phone numbers falling into the five neighborhoods identified above were neglected.
TABLE C2

Comparison of South Coast Air Basin Population to the Population of Neighborhoods Excluded from this Study due to Overlapping Telephone Directories

<table>
<thead>
<tr>
<th>Counties within the South Coast Air Basin</th>
<th>Urban Population (1970 Census)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Riverside County*</td>
<td>231,038</td>
</tr>
<tr>
<td>San Bernardino County*</td>
<td>523,346</td>
</tr>
<tr>
<td>Los Angeles County*</td>
<td>7,032,075</td>
</tr>
<tr>
<td>Orange County</td>
<td>1,311,594</td>
</tr>
<tr>
<td></td>
<td>9,098,053</td>
</tr>
</tbody>
</table>

Five Neighborhoods Falling into Overlapping Phone Directories

<table>
<thead>
<tr>
<th>Neighborhood</th>
<th>Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Downey</td>
<td>88,445</td>
</tr>
<tr>
<td>Norwalk</td>
<td>91,827</td>
</tr>
<tr>
<td>Lynwood</td>
<td>43,353</td>
</tr>
<tr>
<td>Carson</td>
<td>71,150</td>
</tr>
<tr>
<td>Wilmington</td>
<td>30,000**</td>
</tr>
</tbody>
</table>

Notes: *Not population of whole county because only part of the county is in the South Coast Air Basin.

**Estimated
"Which do you think has bothered you more during the last year: inflation or air pollution?"

- Inflation - 0
- Air pollution - 1
- Not sure - 2
- Neither - 3

"The next question concerns benefits from clean air. If you had to choose, which would you like to have most: a doubling of visibility, an elimination of air pollution-caused eye irritation, or a 50 percent decrease in the chance that a nonsmoker will die of lung disease...Again, the benefits are: more visibility, less eye irritation, or less lung disease."

- Visibility - 0
- Eye irritation - 1
- Lung disease - 2
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"To improve visibility, government officials are considering strict limits on air pollution from oil refineries and electric power plants. Although these regulations will cut industry profits, part of the cost will be passed on to consumers. Air pollution scientists predict that tight controls on emissions from these industries, will double visibility. Some days will still be clearer than others, but on any given day, you would see twice as far. Assume that these regulations encourage industry to use the cheapest methods available to reduce pollution, but will still add 10 percent to gasoline prices and electric rates. The cost of doubling visibility to an average family would be 10 dollars per month. Would you be for or against these regulations?"

- For - 0
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APPENDIX D

One interview was conducted in Spanish. The translation of the questionnaire which was used is listed below.

1 ¿Qué diría le ha molestado más durante el año pasado: la inflación o la polución ambiental?

2 Esta pregunta concierne sobre los beneficios de tener un aire limpio. Si Ud. tuviera que elegir, que le gustaría más conseguir: que doblen la visibilidad, que supriman las irritaciones en la vista ocasionadas por la polución en el aire, o que se disminuyan un cincuenta por ciento la probabilidad de que un no fumador muera de alguna enfermedad pulmonar...Nuevamente, los beneficios son: más visibilidad, menos problemas oculares o menos enfermedades pulmonares.

3 Para mejorar la visibilidad, oficiales en el gobierno están considerando aumentar las exigencias sobre la pureza en el aire en las refinerías de petróleo y en las plantas generadoras de electricidad. Aunque parte de estos costos serán solventados desde las ganancias de las compañías, parte de los costos también serán transmitidos al consumidor. Científicos en ingeniería ambiental predicen que los nuevos controles duplicarán la visibilidad. Algunos días serán más limpios que otros, pero en cualquier día, la visibilidad será doble. Suponga por un momento que estas medidas hagan que las empresas elijan los métodos más baratos para reducir la polución en el aire, pero de todas maneras tengan que incrementar un diez por ciento el costo de la nafta y de la energía eléctrica; el costo por familia por mes para doblar la visibilidad será cercano a diez dólares por mes promedio. ¿Estaría Ud. a favor o en contra de estas medidas?

4 ¿Cuántos adultos viven en su casa?