RD

Contractor: The Regents of the University of California, Los Angeles

Contract # 08-325

FUNDING FISCAL YEAR	FY 08/09	FY 09/10	FY10/11	
TERM	6/15/09 - 4/30/09	6/15/09 - 4/30/09	6/15/09 - 4/30/09	
PCA	72360	72360	72360	
LINE-ITEM/OBJECT	398	398	398	
				TOTAL
Contract $	$ 121,754.00	$ 34,787.00	17,393.00	$ 173,934.00
				$ -
				$ -
Total, Contract	$ 121,754.00	$ 34,787.00	$ 17,393.00	$ 173,934.00

Payments to Contractor:							
Inv. #	Inv. Date	Ser Per					C/S
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
						-	
Total, Payments			$ -	$ -	$ -	-	

Balance Available to Pay Contractor	$ 121,754.00	$ 34,787.00	$ 17,393.00	$ 173,934.00
Balance Must Be Spent By:	*6/15/2010*	*6/15/2011*	*6/15/2012*	

Notes:

Contract Manager: Mike Guzzeta

STATE OF CALIFORNIA
STANDARD AGREEMENT
STD 213 (Rev 06/03)

AGREEMENT NUMBER
08-325
REGISTRATION NUMBER

1. This Agreement is entered into between the State Agency and the Contractor named below:

STATE AGENCY'S NAME
Air Resources Board (ARB or State)

CONTRACTOR'S NAME
The Regents of the University of California, Los Angeles (UCLA, University, or Contractor)

2. The term of this Agreement is: June 15, 2009 through April 30, 2011

3. The maximum amount of this Agreement is: **$173,934**
(One hundred seventy-three thousand nine hundred thirty-four dollars and no cents)

4. The parties agree to comply with the terms and conditions of the following exhibits which are by this reference made a part of the Agreement.

Exhibit A – Scope of Work	1 Page
Exhibit A - Attachment 1	37Pages
Exhibit B – Budget Detail and Payment Provisions	2 Pages
Exhibit B – Attachment 1	23 Pages
Exhibit C* – General Terms and Conditions	GIA 101
Check mark one item below as Exhibit D:	
☒ Exhibit - D Special Terms and Conditions (Attached hereto as part of this agreement)	1 Page
☐ Exhibit - D* Special Terms and Conditions	
Exhibit E – Additional Provisions	5 Pages
Exhibit F – Research Report Format	6 Pages

Items shown with an Asterisk (*), are hereby incorporated by reference and made part of this agreement as if attached hereto. These documents can be viewed at www.ols.dgs.ca.gov/Standard+Language

IN WITNESS WHEREOF, this Agreement has been executed by the parties hereto.

CONTRACTOR

CONTRACTOR'S NAME *(if other than an individual, state whether a corporation, partnership, etc.)*
The Regents of the University of California, Los Angeles

BY *(Authorized Signature)* Martha Hansen
DATE SIGNED *(Do not type)* 8/26/09

PRINTED NAME AND TITLE OF PERSON SIGNING
Martha Hansen, Sr. Contract & Grant Administration

ADDRESS
Office of Contract & Grant Administration
11000 Kinross Avenue, Suite 102, Los Angeles, CA 90024-1406

STATE OF CALIFORNIA

AGENCY NAME
Air Resources Board

BY *(Authorized Signature)*
DATE SIGNED *(Do not type)* SEP 01 2009

PRINTED NAME AND TITLE OF PERSON SIGNING
Socorro Watkins, Chief, Business Management Branch

ADDRESS
1001 I Street, 20th Floor, Sacramento, CA 95814

Sharon Simmons
Contract Services Section Manager
Air Resources Board

California Department of General Services Use Only

APPROVED
SEP 17 2009
DEPT OF GENERAL SERVICES

☐ Exempt per:

EXHIBIT A

SCOPE OF WORK

1. The Regents of the University of California, Los Angeles (UCLA, University, or Contractor) agrees to provide services for the project entitled "A Field Experiment to Assess the Impact of Information Provision on Household Electricity Consumption" which is attached hereto as Exhibit A, Attachment 1 and made a part of this Agreement.

2. Term: The term of this agreement is June 15, 2009 through April 30, 2011; however no work shall commence until receipt of final approval from the Department of General Services (DGS). Consequently, all dates contained in the Exhibits and Attachments shall be considered revised to conform to the actual term of this agreement, and the schedule shall not begin until Contractor receives written notice from ARB of final approval by DGS.

3. The project representatives during the term of this agreement will be:

Requesting Agency: ARB	**Providing Agency: The Regents of the University of CA, Los Angeles (UCLA)**
Name: Susan Fischer	Name: Mathew E. Kahn
Air Resources Board, Research Division	University of California, Institute of the Environment
Address: 1001 I Street, 5th Floor Sacramento, CA 95812	Address: La Kretz Hall, Suite 300 619 Charles E. Young Drive, East Box 951496 Los Angeles, CA 90095
Phone: (916) 324-0627	Phone: (310) 794-4904
Fax: (916) 322-4357	Fax: (310) 825-9663
Email: sfischer@arb.ca.gov	Email: mkahn@ioe.ucla.edu

The ARB Contract Administrator is: The University's Contract Administrator is:

Requesting Agency: ARB	**Providing Agency: The Regents of the University of CA, Los Angeles (UCLA)**
Name: Ms. Emma Plasencia	Name: Martha Hansen
Air Resources Board, Research Division	Office of Grant Administration
Address: 1001 "I" Street, 5th Floor Sacramento, CA 95814	Address: 11000 Kinross Ave., Suite 102 Los Angeles, CA 90024-1406
Phone: (916) 323-1524	Phone: (310) 794-0236
Fax: (916) 322-4357	Fax: (310) 794-0631
Email: eplasenc@arb.ca.gov	Email: mhansen@research.ucla.edu

A Field Experiment to Assess the Impact of Information Provision on Household Electricity Consumption

Principal Investigators:

~~Matthew E. Kahn, UCLA~~
Frank A. Wolak, Stanford

Official Authorized to Bind this Proposal:

Martha Hansen, Sr. Contract and Grant Officer

Signature Martha Hansen

Prepared for:

State of California Air Resources Board
Research Division
PO Box 2815
Sacramento CA 95812

Submitted on behalf of:

The Regents of the University of California
11000 Kinross Avenue, Suite 102
Los Angeles CA 90095
(310) 794-0236

Prepared by:
The UCLA Institute of the Environment
January 14, 2009

Study involves human or animal subjects? YES ☑ (humans) NO ☐

Contents

Statement of Significance	3
Abstract	4
Project Objectives	5-7
Technical Plan	8-19
References	19-22
Project Schedule	23
Management Plan	24-26
Curricula Vitae	27-37

Statement of Significance

Residential electricity consumption represents 30% of California's total electricity consumption. The Air Resources Board reports that after the transportation sector, the Electricity and Commercial/Residential Energy sector is the next largest contributor to greenhouse gas (GHG) emissions producing over 30% of the state's total emissions. These two facts highlight that reducing household electricity consumption can help the state achieve its AB32 goals. In the past, technological mandates such as new appliance standards have been effective at reducing household electricity consumption. While such technological improvements will surely play an important role in meeting AB32's goals, household behavioral change is a potentially promising way to reduce electricity consumption in a state where population and per-capita income will continue to rise.

This study will run a field experiment to gauge the cost-effectiveness of various behavioral change campaigns as well as to provide new insights into how to reduce residential household electricity consumption. The purpose of this experiment is to assess the impact of three types of information on a household's ability to manage its electricity consumption. We will test for the causal role of several forms of information provision by comparing electricity consumption over time for a set of households randomly assigned to receive specific types of information about their electricity consumption to the electricity consumption of households randomly assigned to a control group. In this experiment we will focus on three main information treatments. The first is information about the electricity consumption associated with the use of different household appliances. The second is information about how electricity consumption translates into a monthly electricity bill through their utility's increasing block electricity pricing structure. The third is how energy efficiency investments will impact the distribution of energy savings that households achieve from these expenditures.

We hypothesize that the households randomly assigned to receive this information will use it to reduce their monthly electricity bill and their monthly electricity consumption. Using statistical methods for evaluating programs, we will test for direct effects of our treatments and for indirect spillover effects to members of the treated household's peer group. A unique feature of our proposed field experiment is that we will propose a credible research design for studying the role of social networks in disseminating information on ways to reduce household energy consumption.

Results from this study have the potential to serve as the scientific foundation for scaling up ARB's efforts to reduce residential household electricity consumption. They also provide direct benefit to CARB in achieving the goals of AB 32. Specifically, if we find that certain forms of information provision lead to lower electricity consumption for households assigned to the treatment group and for members of their social network who were not directly treated with this information, then electric utilities can apply these findings to the design of information provision programs for all residential customers in California.

Abstract

This project proposes to implement a set of field experiments to examine the role of information provision and peer-to-peer learning as strategies for reducing residential electricity consumption. By partnering with a California electric utility, we will be able to access household monthly electricity bill data *before* and *after* our experiment begins. A subset of households served by this electric utility will be randomly assigned to a treatment group and another set of households will be assigned to a control group. This randomization reduces concerns about self-selection bias. Evidence of an effective "treatment" will be if we observe a statistically significant difference in the change in monthly electricity consumption between the treatment group and the control group following the provision of information to the treatment group.

Unlike in a campus psychology laboratory setting, households in both the treatment and control groups will not be aware that they are participating in an experiment measuring the impact of information provision on their electricity consumption. Their electric utility will contact the subset of households randomly assigned to the treatment group and inquire whether they would be willing to participate in an Internet Instructional Presentation [IIP] (our information provision treatment) that will last no more than twenty minutes. The electric utility will offer participating households a small $35 (on average) credit on their electricity bill for satisfactorily completing the IIP.

During this IIP, the roughly 1,500 households will provide information about themselves and information on items such as their stock of durables in their house. Using information on each household's baseline electricity consumption, we will provide tailored specific information treatments that will help these households reduce their electricity consumption and their electricity bills. In a final module on the IIP, we will ask households to identify various types of friends and acquaintances who live in the same utility district. We will use information on the residential address of those in the treatment group and this social networks information to study whether households who are friends or acquaintances of those in the treatment group but did not directly receive information change their electricity consumption behavior after the treatment group receives our information treatments. Evidence of such spillover effects would be indirect evidence that people are teaching their friends about successful strategies for reducing electricity consumption.

If there is credible evidence of such "local learning" effects based on our a sample of California residential households, then we could use our results to provide recommendations to the Air Resources Board about how to design "educational" programs to residential customers that reduce the electricity consumption of the participants and their friends and acquaintances.

Project Objectives

The main goal of this project is to design and conduct a residential field experiment to generate new knowledge concerning what types of information treatments are effective at reducing household electricity consumption. We plan to test three sets of informational treatments. The exact treatment details will be determined in consultation with the ARB's staff and through collaborative interactions with the California Electricity Commission as initiated under its Statement of Work 500-08-024. The first treatment is information about electricity appliance use translated into electricity consumption. For example, how many kilowatt-hours are consumed per hour of operation of the household's refrigerator, television, computer, dish washer and clothes washer. Armed with this information, households can be expected to be better able to assess the costs and benefits of various electricity conservation activities in their house.

The second type of information is the impact of the household's increasing block tariff on its monthly electricity bill. Recent California legislation such as AB 1763 seeks to provide electricity consumers with more transparent information about their monthly electricity bills and how to lower their expenditures. Providing households with an understanding of where they are located on this increasing block price schedule and suggesting electricity conservation actions can yield significant financial benefits to the household. The third informational treatment teaches households about the potential savings associated with common energy efficiency investments, such as compact florescent light bulbs, high-efficiency appliances, ceiling and wall insulation. The goal of this treatment is provide households with better tools to make energy efficiency investments that make sense given their rate-of-time preference, tolerance for risk, and willingness to take actions to reduce their electricity consumption.

The second major goal is to measure whether there is credible evidence of "spillover" effects such that households teach other households about ways to reduce their electricity consumption. Duflo and Saez (2003) have recently presented evidence on retirement planning that is consistent with the hypothesis that work peers learn from each other. Such "local learning" effects in which neighbors teach neighbors, workers teach fellow workers, and friends teach friends would mean that cost-effective techniques can quickly diffuse across individuals and in aggregate help California to achieve the AB32 greenhouse gas mitigation goals.

To generate credible estimates of information's causal role in changing household behavior, we must be able to compare comparable households who do and do not receive this information. Ideally, this information should be randomly assigned across the population. Such random assignment means that the average treated household is identical to the average control household and thus any statistical difference in electricity consumption behavior between these households must be attributable to the specific treatment that was offered to the treatment group but not to the control group. In contrast, if households can select and choose whether they want to receive this information, then the typical household who chooses to take the treatment is likely

to be more responsive to this information than a random household in California as a whole. In recent years, economists have devoted ample attention to this issue of self-selection and how it affects our ability to make causal inferences in evaluating whether a specific treatment is effective. A field experiment with random assignment to the treatment status is a credible strategy for consistently estimating average treatment effects.

The proposed objectives are the following:

- To study the direct impact of information on consumption on monthly electricity consumption
- To elicit information using a unique survey we will design to learn about residential consumer impatience, information and knowledge about electricity pricing
- To use information revealed by our survey to explain differences across households with respect to their baseline electricity consumption.
- To study the role of peer-to-peer spillover effects and "local learning" on encouraging energy conservation. Do people who are randomly assigned to the treatment group teach their friends about what they have learned?

Table 1 presents the major tasks that will be accomplished to achieve the objectives listed above. At the conclusion of the project a final report, and files with relevant information/data used in the study in a form suitable for archiving will be submitted to the ARB. The final report will include a comprehensive summary and discussion of all the topics and issues addressed in this research project as well as suggestions for future policy relevant research. Results will also be documented as one or more technical papers published in peer reviewed economics journals.

Table 1: Description of the tasks to be conducted in this project

Task	Description
1	Identify a California electric utility to partner with us to run this field experiment.
2	Households will be randomly assigned to a treatment group and a control group. Households assigned to the treatment group would receive an electricity bill insert that we would write in consultation with social science researchers currently working with the California Electricity Commission under SoW 500-08-024. The electric utility would send out this bill insert as part of a household's monthly electric bill. This bill insert would instruct randomly selected households to go to the Internet and to log on and fill out our survey questions.
3	We will write a detailed Internet survey that can be accessed on the web. This will create a household level data base. During this 20 minute survey, households will provide

information on their basic socio-demographics and the types of electricity consuming durables in their home. During the survey the household will receive a tutorial on how its appliance use translates into electricity consumption. The household will also be instructed on how the tiered electricity pricing system works. Based on the household's baseline electricity consumption, we will inform them of how they could change their behavior to move to a lower electricity tier. The survey will also generate household level information on how households differ with respect to their patience, and risk aversion. This survey will also review potential energy and electricity savings from energy efficiency investments. In order to study peer spillover effects, the survey will ask households to reveal the names and email addresses of good friends who live in the same service area who they feel might gain from new information on how to reduce their electricity consumption. We recognize that privacy concerns may discourage some households from providing this information. We will work to write clear language that prompts households without violating their privacy.

4 For each household assigned to the treatment group and the control group, the electric utility will provide us with each household's electricity consumption starting three months before the experiment begins and continuing 6 months after the experiment starts. This will yield at least 9 months of data for each household in the experiment. We will sign confidentiality agreements promising not to disclose any participants' information.

5 We will analyze the baseline data for our treatment group and control group.

6 As time passes for the six months after the start of the experiment, the electric utility will provide us with each of experiment participants' monthly electricity consumption. We will also be provided with information on the monthly electricity consumption of identified friends of each experiment participant (see Step 3 above). We will work with the electric utility to protect the privacy of individual households. Ideally, the electric utility will be in charge of assigning a unique identifier to each household so that we can trace the household's monthly electricity consumption over time without knowing the head of household's name or other identifying information. We will use multivariate statistical analysis to test for the causal effects of the treatments we introduce.

7 Quantification and program evaluation on cost-effectiveness criteria

8 Draft final report

9 Prepare and submit final project deliverables

Technical Plan

1. Introduction

The purpose of this experiment is to assess the impact of information provision on a households' ability to manage its electricity consumption. Electricity consumption is derived from a household's demand for the services provided by electricity-using appliances—lighting, heating, cooling, refrigeration, and television and computer use are major electricity consumers at the household level. However, few households know how much electricity each appliance uses, and this may prevent the household from minimizing the monthly cost of purchasing its desired bundle of electricity-using services. Few households also know about the distribution of likely energy savings associated with a number of common energy efficiency investments such as ceiling insulation, double pane windows, and energy-efficient electric appliances. Finally, few households understand the impact on its monthly electricity bill of the increasing block price schedule used to compute monthly residential electricity bills for California's three large investor-owned utilities.

This experiment seeks to simultaneously study how treated households alter their electricity consumption in response to the provision of this information and to examine whether members of the same social network as this household also alter their electricity consumption, presumably as a result of indirectly receiving some or all of this same information from the treated household.

2. Experimental Design

In order to run our experiment, we need to partner with at least one California electric utility. The electric utility collects the monthly electric consumption data, which is the key variable we plan to use to determine whether households are changing their behavior in the face of the treatments we introduce. The electric utility is also a credible proven entity to each household. All household are likely to open their monthly electricity bill, and in collaboration with social scientists from CEC SoW 500-024-08 we will design audience-specific inserts with the maximum probability of being read."

Our field experiment will quantify the extent to which the lack of information about how appliance use translates into electricity consumption, knowledge of the form of the nonlinear price schedule faced by the household, and the lack of information about the costs and benefits of investing in various energy efficiency strategies impacts Californian household electricity demand. If our information treatments are shown to reduce a households' demand for electricity and the demand of its peers, then targeted energy education programs are likely to be a low-cost option for California to achieve its greenhouse gas emissions reduction goals under AB32. As stated in the September 2008, California Public Utility Commission document titled California

Long Term Efficiency Strategic Plan, efforts to encourage energy efficiency will be a key emphasis of ongoing policy. Our experimental design offers a credible approach for identifying effective treatments.

We now lay out the major steps of conducting our proposed experiment. These steps are based on the assumption that we have identified electric utilities within California who will work with us on conducting our experiment. We are highly optimistic that we will be able to identify such partners. AB32 will create strong incentives for the state's electric utilities to seek out creative methods for reducing residential and commercial electricity consumption. We have already been in touch with the Sacramento Municipal Utility District, Pacific Gas and Electric and Southern California Edison as potential utility partners for our experiment.

Step #1: **Choosing our sample.**

In Step #3 below, we discuss how we will use an Internet Survey to simultaneously learn about households who participate in our field experiment and to teach them relevant facts about their current electricity consumption. We recognize that households differ with respect to their Internet access. Some households own computers and have a modem and/or broadband Internet connection, while other households may not own a personal computer. If we were to ignore this fact in deciding which households to send bill inserts to, our study is likely to over-sample computer literate people. Those households with computers would be more likely to visit the web-site to take our survey if they received our bill insert, whereas those without a computer or internet access in their home would be less likely to visit our web-site and participate in the survey. Inferences based on such a sample would be unlikely to generalize to the population of utility customers.

To address this issue, we plan to employ a stratified sampling process that over-samples geographic areas where we know households can easily obtain access to the Internet through public libraries or other easily-accessible venues. We will provide instructions for accessing the Internet through these venues on the bill inserts. Because we are measuring the impact of information provision on electricity consumption for households financially motivated to reduce their electricity consumption, we will also stratify our sample to focus on geographic areas with single family or multi-family dwellings where the occupant pays their own electricity bill. This sampling scheme will be designed to achieve the highest possible expected response rate to our bill inserts and to ensure that the largest possible number of households in our treatment and control groups are metered and pay their own electricity bill, rather than having it included in their rent.

Because each California household's residential street address can be geocoded to determine which census tract and which census block the household lives in, we can use information from the 2000 Census of Population and Housing to link detailed demographic

information for their census tract and census block to each household we might sample. This information will allow us to stratify our sample based on the type of dwellings that exist in that census tract or census block. We can also use this information to measure which demographic factors for that household's census tract or census block predict a greater probability of non-response to our bill insert. There are variety of statistical methods that we can employ to control for the impact on non-random response to our bill inserts that will make use of the demographic information from the 2000 Census of Population and Housing.

We also plan to use the 2003 Current Population Survey (CPS) to measure the probability that each household that we might send a bill insert to owns a computer. The CPS is a nationally representative survey that asks a household whether its members have a personal computer and whether they have internet access.[1] We can use this dataset to estimate a probability model to determine how household demographics collected by the CPS such as age, education, ethnicity are associated with the probability of having Internet access. These regression coefficients (estimated using the CPS data) will provide us with another way to assess the extent to which non-response to our bill insert is systematic. For example, we can compare the frequency of non-response as predicted by data from the CPS to the frequency of non-response that we observe in our sample for the same demographics.

Once we have selected a stratified sample to focus on dwellings where the occupants must pay their electricity bill and regions where those that do not have in-home Internet access have nearby public access to the Internet, we will ask the electric utility to randomly select at least 2,000 households according to this sampling scheme and to provide us with their monthly electricity data for at least the three months of electricity consumption prior to the start of the experiment. To minimize that number of households that do not respond to the bill inserts, we will work with the electric utility to schedule several rounds of follow-up phone calls to these households asking them to complete the survey and giving verbal instructions to those households needing directions to a public location to access the Internet. The first round of follow-up phone calls will occur within a week of mailing out the bills and a second-round of follow-up calls will occur a week later.

Step #2 **Randomization**

We will randomly assign the selected households to the treatment group and the control group. Those households assigned to the control group will receive no information from us during the experiment. Disclosing that we will be using information on their monthly electricity consumption to them would clearly undermine the validity of our approach to estimating the population treatment effect. Households in the treatment groups will be directed to a web-page through a bill insert that promises a pre-specified credit of $25 to $75 applied to their next

[1] See http://www.census.gov/population/www/socdemo/computer.html.

month's electricity bill after completing the web survey and electricity education process. We plan to randomly choose numbers for the value of the payment so that the average payment to all treated households is $35. By varying the magnitude of the bonus for participating in our survey, this allows us to implement statistical techniques that correct our treatment effect estimates to account for the fact that some electricity customers that are assigned to our treatment group may choose not to be treated by declining to take our survey. We suspect that households receiving the promise of a higher payment will have a smaller probability of deciding not to complete the survey. We do not believe that the size of the payment offered should impact the electricity consumption reduction that the household will realize from receiving our treatment, which makes this variable an ideal one to control for the household's decision to complete our web-survey in computing our estimate of the population treatment effect. Similar to the control group, the treatment group will not know that they are participating in an experiment. The electric utility will truthfully inform them that the survey they will fill out will provide useful information that will allow the utility to improve the design of its energy efficiency program.

Step #3: **Survey Design and Data Collection**

The first section of the web survey will focus on collecting demographic information and other housing structure information such as the size of the housing unit, the number of bedrooms, total square footage, and whether the household is an owner or renter. Information on the composition of the occupants of the dwelling will also be collected such as the age, sex, and education level of each occupant, including the one completing the survey. We intend that the survey will be filled out by an adult in the household. The survey will be designed in consultation with other social scientists to increase the likelihood that households accurately reveal sensitive information such as income. We will pre-test on how to ask such delicate questions and we will use information on the household's census block's characteristics based on the year 2000 Census of Population and Housing. The Census provides information on average household income by census block.

The survey will then review the computation of the household's electricity bills over the past three months. The household will be introduced to the structure of the increasing block price structure and the household's electricity consumption for each of these months will be placed on this price schedule. Here we will make use of the consumption data provided to us by the partner utility to place the customer's actual consumption for the past three months on this price schedule, so the household can see how actions intended to reduce its electricity consumption could translate into much lower electricity bills if it moved to lower pricing tier.

The survey will then gather information on the household's appliance holdings and appliance use. Ideally, we can gather sufficient information about the appliances owned to obtain credible estimates of the amount of electricity consumed as a result of the household using

each appliance. We hope to gather detailed enough information about these appliances to be able accurately measure the kilowatt-hours of electricity consumed per hour of use for each of the major appliances and relay this information to the customer. We would also like to learn the baseline utilization of each major appliance used by the household. For example, does the household head leave his or her computer on 24 hours a day and only use it 2 hours per day? How many hours a day does the household have the television on? How many times a week does the household run their dishwasher or clothes washer and dryer?

In this survey phase's final segment, we will use the information on appliance use and appliance holdings to provide recommendations for the household to alter its consumption to reduce their monthly electricity bill. For example, the household could be told if they run their dishwasher every other day as opposed to every day this could reduce their monthly electricity bill by are certain amount, plus or minus some standard error. This can be accomplished by showing the household's previous month consumption and where it is located on the increasing block structure and then showing the likely new consumption level as a result of the behavioral change and reduced bill amount that would result.

The second phase of the web survey will ask households about their preferences for hypothetical energy efficiency investments. Researchers such as Lutzenhiser (1993) have offered several plausible explanations for why households do not embrace seemingly cost-effective strategies for reducing their electricity consumption. We seek to use our field experiment to test some of these hypotheses. Households would first be offered options for guaranteed energy savings and up-front costs and ongoing costs to achieve them. The goal of these questions is to obtain an estimate of the household's risk-free rate-of-time preference, how many dollars the household is willing to pay today to obtain a dollar with certainty at different dates in the future. Then households will be asked about their preferences for hypothetical uncertain lotteries. For example, in the simplest lottery the household might be offered to choose between $100 for sure or a 50% chance of winning $200 and a 50% chance of winning $0. While these two lotteries have the same expected value, a risk averse person would choose the sure thing. These questions are designed to assess the household's degree of risk aversion for energy-efficiency investments. Finally, the household would be asked about their preferences over hypothetical lotteries for energy savings that they can achieve through their own efforts. For example, a 10% energy savings if the household can wash dishes every other day, versus every day.

The household would then be asked for their assessment of the likelihood that they will be able to take these actions and thereby achieve these energy savings. These questions are designed to jointly quantify the household's rate-of-time preference, degree of risk aversion and opportunity cost of time to take action to reduce their electricity consumption. These hypothetical energy savings will be designed to be as realistic as possible for the household's

actual dwelling and appliance stock. Households will be notified of this intention. The goal of this portion of the survey is to allow the household to make more informed decision about the distribution of benefits and costs associated with several common energy efficiency investments.

The third phase of the survey will ask households about three classes of peers that might benefit from the information they obtained from this web survey. Households will then be asked to provide the e-mail addresses and mailing addresses of three peers from three separate groups: (1) those at work, (2) those that live nearby, and (3) their closest friends. One way to design this portion of the survey is to increase the financial reward paid to these households for getting households in each of these groups to visit the web-site and take a version of the web-survey that does not include this third component. To the extent possible, the monthly consumption of all households listed by this initial household—those that visit the web-site and those that do not—will then be followed both before and after the intervention of visiting the web-site.

To guarantee that we have a high quality survey, we will pay careful attention to the insights from ongoing research taking place at the California Energy Commission. We understand that Dr. Loren Lutzenhiser is conducting research on how a household's attitudes impact their electricity consumption. We plan to incorporate the lessons learned from this California Electricity Commission research (SoW 500-02048) into the design of our survey.

We will extensively pretest this survey using our students at UCLA and Stanford to see how they respond to it and we will use their feedback to improve it before we launch it in the field. We will also work closely with the electric utility to see if they are confident that their customers will understand our questions and are likely to provide high quality, accurate answers.

3. Empirical Analysis

Cross-Sectional Analysis

Our household level survey will yield unique data on household demographics, household endowments of different types of electricity consuming durables, and new estimates of each household's patience and risk aversion. In our first step of the research, we will use this information and baseline electricity consumption data from the electric utility to study at a point in time what is the relationship between household electricity consumption and household demographics, durables endowments, household patience and risk aversion. Define $Electricity_{j,-1}$ as household j's electricity consumption in month -1 (the month before our experiment begins). For the subset of households assigned to the treatment group who choose to participate in our survey, we will estimate:

$$Electricity_{j-1} = c + \mu_1 * Demographics + \mu_2 * Patience + \mu_3 * Risk\ Aversion + U_{j-1}$$

This cross-sectional regression will be useful for directly testing for the role of impatience and risk aversion in explaining why households differ with respect to their electricity consumption. We hypothesize that impatient households and risk averse households should be less likely to purchase new expensive but energy efficient durables and this should directly translate into higher electricity consumption holding other demographic factors constant. Ordinary least squares estimates of μ_2 *and* μ_3 provide a direct test of this claim. In addition to estimating this cross-sectional regression, we will run additional cross-sectional regressions where we use our demographic measures such as household head educational attainment to predict patience and risk aversion. This should be useful information for the ARB as it predicts how household electricity consumption will evolve as population demographics change over time.

Longitudinal Analysis

We anticipate that the electric utility will provide us with at least 9 months of monthly electricity data per household. This dynamic data is a crucial input in allowing us to studying the consequences of the randomized treatments that we introduce. We will merge our household level baseline survey data to the electric utility's monthly household electricity data to create a longitudinal data set. The key point is that this data set allows us to follow a given household's electricity consumption over time and we observe the electricity consumption of multiple households at any point in time.

We will use this longitudinal data to implement a straightforward difference of "before/after" comparisons for households randomly assigned to the treatment group and household assigned to the control group. The difference in consumption for households in the control groups accounts for background trends in monthly consumption unrelated to the treatment and the different in consumption of the treatment group contains this background trend and the treatment effect, so that the difference between before/after difference for the treatment group and the before/after difference for the control group is our estimate of the treatment effect. We now expand on this point by introducing some algebra.

Define $Electricity_{jm}$ as household j's electricity consumption in month m. For simplicity assume that months are measured relative to the start of the experiment. If the experiment starts in July 2009 then in that month m equals 0.

In evaluating which treatments are effective, our key outcome indicator is $Electricity_{jm}$. We model household monthly electricity consumption as a function of a time invariant household fixed effect, α_j and a monthly fixed effect α_m. The household fixed effect explicitly

acknowledges that households differ with respect to time invariant attributes such as household lifetime savings and wealth, and the specific type of home they live in. The monthly fixed effects acknowledge that over time as weather changes that households will change their electricity consumption. Note that this monthly fixed effect does not have a household subscript. We assume that control and treatment households respond in the same way to events that vary over time within the same electric utility service area.

In a linear regression framework, we model household monthly electricity consumption as:

$$Electricity_{jm} = \alpha_j + \alpha_m + \beta * Treatment_{jm} + U_{jm}$$

In this equation $Treatment_{jm}$ is an indicator variable that equals one if household j is in the treatment group in month m. It is important to note that this variable varies across households, because some households are randomly assigned to treatment while some are not. For any household assigned to the treatment group, this variable also varies over time as we observe the household's electricity consumption before the experiment begins. The variable U_{jm} represents unobserved time varying determinants of electricity consumption for household j in month m.

We use this regression framework to estimate the energy consumption change caused by our information treatments. For a given treatment, if we cannot reject the null hypothesis that β equals zero then we will conclude that this treatment is not effective at reducing household electricity consumption.

Our econometric techniques represent a "double-difference" experimental design with random assignment to treatment. To appreciate this point, consider the average change between month 0 and month m in electricity consumption for households who are randomly assigned to the control group (i.e., the Treatment indicator variable equals 0). Define E() as the expectations operator. By assumption $E(U_{jm})$ equals zero. We normalize α_0 to equal zero.

$$E(Electricity_{control,m} - Electricity_{control,0}) = \alpha_m$$

This equation represents the "before/after" comparison for households assigned to the control group. In contrast, consider the average electricity change in behavior between month 0 and month m for households randomly assigned to the treatment group.

$$E(Electricity_{treatment,m} - Electricity_{treatment,0}) = \alpha_m + \beta$$

This equation highlights how the treated group's "before/after" average change differs from the "before/after" average change for the control group.

The key role played by β as the key evaluation parameter becomes clear from calculating the "double difference";

$$E(Electricity_{treatment,m} - Electricity_{treatment,0}) - E(Electricity_{control,m} - Electricity_{control,0}) = \beta$$

Intuitively, β represents the average change in energy consumption for the treatment group relative to the control group. For example, if both the treatment group and the control group on average increased their electricity consumption by three units, then β would equal zero. The control group's average change in electricity consumption provides a counter-factual measure of what the treatment group's average change in electricity consumption would have been had the treatment group not been treated.

In implementing our empirical strategy, we recognize that some households who are randomly assigned to the treatment group may choose to not fill out our survey. We will observe the electricity consumption dynamics both for households assigned to the treatment group who do and do not fill out our survey. By randomly assigning a bonus for filling out our survey, we expect that we will induce some households assigned to the treatment group to fill out the survey. For the set of households randomly assigned to the treatment group, we will estimate a survey participation equation to estimate the role that the bonus plays in increasing the probability that a random household fills out the survey. This *participation equation* is a key input in providing us with a robustness test for our estimates. This information will allow us to test how our treatment effects estimates are affected by explicitly incorporating a selection correction.

We will also use the information collected on the household's demographic characteristics, rate of time preference, and degree of risk aversion to measure the extent to which our treatment effect differs across households as a function of these variables. To do this, we will estimate regressions of the form

$$Electricity_{jm} = \alpha_j + \alpha_m + \beta_1 * Treatment_{jm} + \beta_2 * Survey_j * Treatment_{jm} + U_{jm}$$

where $Survey_j$ is the value of a survey variable such as the household's income, its rate of time preference, or degree of risk aversion. For this linear regression model, the treatment effect now varies with the value of $Survey_j$. Specifically, it is equal to: $\beta_1 + \beta_2 * Survey_j$. For example, if $Survey_j$ is equal to the natural logarithm of household j's annual income, then if β_2 and β_1 are negative, higher income households experience a larger electricity consumption reduction as a result of our information treatment. Understanding the determinants of the heterogeneity in our treatment effect can help to design information provision programs that achieve the greatest possible consumption reduction.

4. Testing for Peer Effects

Recall that for each household j in the treatment group we will know their street address and thus can identify their closest residential neighbors. We will ask the electric utility to provide us with monthly electricity consumption data for households who live very close to the treated households. If treated households speak to their neighbors, then peer to peer learning could be taking place in the residential community. In addition, for each household who fills out our survey, we will ask them to identify 3 to 5 friends by providing us with each friend's email and mailing address information. We will use information and ask the electric utility to provide us with monthly electricity consumption for this group. Call this set of households the "friends".

Our indirect test of "peer effects" is to pool the electricity consumption data of those households randomly assigned to the control group with the data from the "friends" sample (or the residential neighbor sample) and to estimate this linear regression.

$$Electricity_{jm} = \alpha_j + \alpha_m + \delta * Friend\ Treatment_{jm} + U_{jm}$$

In this regression, the indicator variable $Friend\ Treatment_{jm}$ equals one if person j was identified as a friend of a member of the treatment group and by month m the treatment has taken place. This variable equals zero if the household was randomly assigned to the control group and is not identified as a friend of anyone in the treatment group. Friend Treatment also equals zero if the treated household has not been treated in the month in question. After all, a friend cannot teach you something that he has not yet been taught. Note that friends of people in the treatment group receive no direct information from us. Statistical evidence of peer to peer learning would be if δ is statistically significant and less than zero. We will repeat this same approach in order to test whether residential neighbors are learning from their neighbors who are randomly assigned to the treatment group.

It is important to note that by creating a high quality Internet Instructional Presentation, we are more likely to find credible evidence of peer to peer learning. If a friend recognizes that he has had a valuable educational experience, then he is more likely to tell his friends about this versus if he feels that he has wasted his time on a meaningless activity.

In an extension of our peer effects design, we will introduce one more randomization for the set of households who are assigned to the treatment group. For a subset of these households, we will assign them to a "prompt" group. For this subset of treated households, we will actively encourage them to talk to the friends they have named to teach them about what they have learned. For the other households in the treatment group we will not prompt them to talk to their friends. This exogenous variation will provide direct evidence on whether electric utilities can mobilize social networks to achieve electricity consumption reductions.

Relevant Prior Literature

A long empirical literature has examined the determinants of residential electricity consumption. Our reference list below provides the start of a comprehensive list of studies conducted in the 1970s, 1980s, 1990s and recently examining the role of economic incentives, information, and psychological influences in determining residential electricity consumption. In this selective literature review, we highlight just a subset of these papers.

Our survey will provide unique household level data on how households differ with respect to their patience (i.e the willingness to sacrifice a dollar today to save more than a dollar in the future) and their degree of risk aversion. An ongoing economics literature has investigated the role of patience in determining energy efficiency investments. Many energy efficient durables such as refrigerators and air conditioning units cost more up front but require less electricity later. Economists have studied household choices over these different durables and concluded that people reveal a high rate of impatience (Hausman (1979), Frederick, Loewenstein, and O'Donoghue (2002), Hassett and Metcalf (1993), Howarth and Sanstad (1995), Train (1995)). Impatience may be an explanation for the "energy paradox" that green durables and practices that energy engineers advocate have only slowly diffused across actual households (see Sanstadt, Hanemann, & Auffhammer, 2006, Biggart and Lutzenhiser (2007) for a review). By quantifying proxies for household patience, we will evaluate whether more patient people consume less electricity at the baseline and respond differently to our randomly assigned treatments than the average person.

A large psychology literature has examined how households respond to information, learning and reinforcement about energy consumption issues (Seligman, Becker, and Darley 1981, Ester and Winett 1982). Based on his comprehensive survey, Lutzenhiser (1993) emphasizes that energy "illiteracy" is an important determinant of electricity consumption. Our field experiment will contribute to this literature by directly testing this claim. If this statement is true, then our information treatments on the energy pricing tier system and the relationship between appliance utilization and electricity consumption should both help to reduce consumption. These findings will contribute to earlier empirical work by Wilhite and Ling (1993) and Darby (2006).

Today, we are aware of one other information based approach in California that intends to change household electricity behavior. In a partnership between the for profit company Positive Energy and the Sacramento Municipal Utility District, households are randomly chosen to receive a statement alerting them about their monthly electricity consumption over the last 12 months and using a graphical format these treated households see a comparison of their

electricity consumption trends relative to their closest residential neighbors. Using electricity consumption data provided by SMUD, Positive Energy's "treatments" are estimated to reduce electricity consumption by 2.4% (discussion with Bruce Ceniceros at SMUD and Alex Laskey, President of Positive Energy). Matthew Kahn is involved in ongoing conversations with Alex Laskey, the President of Positive Energy, to find common ground where we can work with each other. It is important to note that the Positive Energy team is focusing on social pressure (i.e. Keeping Up with the Jonses) as a means to change behavior. In contrast, our experiment focuses on the role of different types of information (i.e the non-linear pricing structure) and we are interested in testing for the role of social networks beyond one's residential neighbors.

As presented in Section 4.4, our field experiment will allow us to test for peer spillovers. Recently economists have devoted ample attention for testing for peer learning in many different contexts. Duflo and Saez (2003) examine how workers employed at the same department at a major research university respond to retirement planning information. They conducted a field experiment in which a group of employees were randomly assigned to receive a retirement education lesson on financial planning. They document that workers in the same department who were not assigned to the treatment group may have learned about the benefits of enrolling in a tax deferred account retirement plan from their friends who were randomly assigned to the treatment group.

References and Related Research

Abrahamse, Wokje; Steg, Linda; Vlek, Charles; & Rothengatter, Talib. 2005. A Review of Intervention Studies Aimed At Household Energy Conservation. *Journal of Environmental Psychology*, 25, 273-91.

Becker, L. J., Seligman, C., Fazio, R. H., Darley, J. M. 1981. Relating attitudes to residential energy use. *Environ. Behav.* 13:590-609.

Brandon, G. A. Lewis, 1999, Reducing household energy-consumption: a qualitative and quantitative field study, *Journal of Experimental Psychology* 19 75–85.

Biggart, Nicole and Loren Lutzenhiser. 2007, Economic Sociology and the Social Problem of Energy Inefficiency, *American Behavioral Scientist* Volume XX Number X.

Black, S. J., Stem, P. C., Elworth, J. T. 1985. Personal and contextual influences on household energy adaptations. *J. Appl. Psychol.* 70:3-21.

California Air Resources Board, 2008 Climate Change Proposed Scoping Plan.

California Energy Commission (CEC), Mike Messenger, Principal Author. 2003. *Proposed Energy Savings Goals for Energy Efficiency Programs In California.* Staff report prepared in

support of the 2003 Integrated Energy Policy Report Proceeding (02-IEP-01). CEC #100-03-021, October 27.

California Public Utilities Commission, September 2008, Long Term Energy Efficiency Strategic Plan.

Coltrane, S., Archer, D., Aronson, E. 1986. The social-psychological foundations of successful energy conservation programmes. *Energy Policy* 14: 133-48.

Costanzo, M., Archer, D., Aronson, E., Pettigrew, T. 1986. Energy conservation behavior--The difficult path from information to action. *Am. Psychol.* 41:521-28.

Craig CS, McCann JM. 1978. Assessing communication effects on energy conservation. *J. Consum. Res.* 5:82–88.

Darby, S. 2006, The Effectiveness of Feedback on Energy Consumption: A Review for DEFRA of the Literature on Metering, Billing and Direct Displays. http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf.

Dennis, M.L, E.J. Soderstrom, W.S. Koncinski, B. Cavanaugh, 1990, Effective dissemination of energy related information, *American Psychologist* 45 (10) 1109–1117.

Dillman, D. A., Rosa, E. A., Dillman, J. J. 1983. Life-style and home energy conservation in the U.S.J. *Econ. Psychol.* 3:299-315.

Duflo, Esther and Emmanuel Saez, 2003, The Role of Information and Social Interactions in Retirement Plan Decisions: Evidence From a Randomized Experiment", *Quarterly Journal of Economics*, 118, 2003, 815-842.

Frederick, Shane, and George Loewenstein, Ted O'Donoghue. 2002. "Time Discounting and Time Preference: A Critical Review." *Journal of Economic Literature* Vol. XL, June: 351-401.

Gately, Dermot. 1980. "Individual Discount Rates and the Purchase and Utilization of Energy-using Durables: Comment." *Bell Journal of Economics* (11) 3, Spring, pp. 373-4.

Hassett, Kevin A., and Gilbert E. Metcalf. 1993. "Energy conservation investment: Do consumers discount the future correctly?" *Energy Policy* 21 (6): 710-716.

Hausman, Jerry. 1979. "Individual Discount Rates and the Purchase and Utilization of Energy-Using Durables." *Bell Journal of Economics* 10 (1): 33-54.

Hayes, S.C, J.D. Cone, 1977, Reducing residential electricity energy use: payments, information, and feedback, *Journal of Applied Behavior Analysis* 10 425–435.

Heberlein, T. A., Warriner, G. K. 1982. The influence of price and attitude on shifting residential electricity consumption from on to off-peak periods. *J. Econ. Psychol.* 4:107-30.

Howarth, Richard B. and Alan H. Sanstad. 1995. "Discount Rates and Energy Efficiency." *Contemporary Economic Policy* 13 (3) (July), 101-109.

Lutzenhiser, L. 1993, Social and Behavioral Aspects of Energy Use. *Annual Review of Energy and the Environment*, 18(1), 247-89.

Macey, S. M., Brown, M. A. 1983. Residential energy conservation: The role of past experience in repetitive household behavior. *Environ. Behav.* 15(2):123-41.

McMakin AH, Malone E, Lundgren RE. 2002. Motivating residents to conserve energy without financial incentives. *Environ. Behav.* 34:848–63.

Meier, Alan K., and J. Whittier. 1983. "Consumer Discount Rates Implied by Purchases of Energy-Efficient Refrigerators." *Energy* 8 (12): 957-962.

McClelland, L. S. Cook, 1980, Energy Conservation effects of continuous in-home feedback in all-electric homes, *Journal of Environmental Systems* 9 169–173.

Midden, C. J. H., Meter, J. E., Weening, M. H., Zieverink, H. J. A. 1983. Using feedback, reinforcement & information to reduce energy consumption in households. *J. Econ. Psychol.* 3:65-86.

Olsen, M. E. 1981. Consumer attitudes toward energy conservation. *J. Soc. Issues* 37:108-31.

Ritchie, B., McDougall, G. 1985. Designing and marketing consumer energy conservation policies and programs: Implications from a decade of research. *J. Public Policy Mark.* 4:14-

Sanstad, Alan H. 1993. "Consumer Energy Research: A Critical Survey." Lawrence Berkeley Laboratory LBL-33555/UC-350.

Schipper L, Bartlett S, Hawk D,Vine E. 1989. Linking life-styles and energy use: a matter of time? *Annu. Rev. Energy* 14:273–320.

Schultz PW. 1999. Changing behavior with normative feedback interventions: a field experiment of curbside recycling. *Basic Appl. Soc. Psychol.* 21:25–36.

Seligman, C., Becker, L. J., Darley, J. M. 1981. Encouraging residential energy conservation through feedback. In *Adv. Environ. Psychol.*, ed. A.

Seligman, C. J.M. Darley, 1977, Feedback as a means of decreasing residential energy-consumption, *Journal of Applied Psychology* 62 363–368.

Seligman C, Becker LJ, Darley JM. 1978. Behavioral approaches to residential energy conservation. *Energy Build.* 1:325–37.

Stern, P. C. 1992. What psychology knows about energy conservation. *Am. Psychol.* 47:1224-32.

Stern, P, C., Aronson, E., eds. 1984. *Energy Use: The Human Dimension.* Washington, DC: Natl. Acad. Press.

Stern, P. C., Aronson, E., Darley, J. M., Hill, D. H., Hirst, E., et al. 1986. The effectiveness of incentives for residential energy-conservation. *Eval. Rev.* 10:147-76.

Train, Kenneth. 1985. "Discount Rates in Consumers' Energy-Related Decisions: A Review of the Literature." *Energy* 10 (12): 1243-1253.

Van Houwelingen, J.T. W.F. Van Raaij, 1989, The effect of goal setting and daily electronic feedback on in-home energy use, *Journal of Consumer Research* 16 98–105.

Vine, Edward L. 1994, The Human Dimension of Program Evaluation. *Energy*, 19(2), 165-178.

Wilhite H., Ling, R. 1992. The effects of better billing feedback on electrical consumption: A preliminary report. *Proe. Am. Counc. Energy Effic. Econ.*, pp. 10.173-75. Washington, DC: ACEEE Press.

Wilhite, H. R. Ling, 1995, Measured energy savings from a more informative energy bill, *Energy and Buildings* 22 (2) 145–155.

Wilson, C. & Dowlatabadi, H. 2007, Models of Decision Making and Residential Energy Use. *Annual Review of Environmental Resources*, 32(2), 1-35.

Yates, S. M., Aronson, E. 1983. A social psychological perspective on energy- conservation in residential buildings. *Am. Psychol.* 38:435-44.

Project Schedule (05.01.09 – 09.30.10)

Task 1: Identify electric utility
Task 2: Write and mail bill insert
Task 3: Write and post survey
Task 4: Respondents complete surveys
Task 5: Analyze baseline data
Task 6: Collect 9 months of subsequent electricity bills
Task 7: Analyze and estimate statistical models
Task 8: Draft final report
Task 9: Prepare and submit final project deliverables

	Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Task																		
1																		
2																		
3																		
4																		
5																		
6																		
7																		
8																		
9																		
		m		p		mp		p		m		p		m		p	d	f

p = Progress report m = Research team meeting d = Deliver draft final report f = Deliver final report

Anticipated Personnel Work Plan

	Month:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
Personnel (Name and Classification)	Task No.																		Total hrs by task.
M. Kahn	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Principal	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Investigator	3	32	16	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
	5	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	80
	7	0	0	0	0	0	40	40	40	40	40	40	40	40	40	80	80	0	520
	8	0	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	200
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16
Subtotal		50	16	32	0	80	40	40	40	40	40	40	40	80	80	120	120	56	914
F. Wolak	1	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16
Co-Principal	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Investigator	3	32	16	32	0	0	0	0	0	0	0	0	0	0	0	0	0	0	80
	5	0	0	0	0	80	0	0	0	0	0	0	0	0	0	0	0	0	80
	7	0	0	0	0	0	40	40	40	40	40	40	40	40	40	80	80	0	520
	8	0	0	0	0	0	0	0	0	0	0	0	0	40	40	40	40	40	200
	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	16	16
Subtotal		50	16	32	0	80	40	40	40	40	40	40	40	80	80	120	120	56	914
Student - web	3	176	184	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	528
Subtotal		176	184	168	0	0	0	0	0	0	0	0	0	0	0	0	0	0	528
Student	5	0	0	0	168	176	0	0	0	0	0	0	0	0	0	0	0	0	344
	6	0	0	0	0	0	48	48	48	48	24	24	24	24	24	0	0	0	312
	7	0	0	0	0	0	128	120	182	162	56	68	64	60	64	64	64	0	1032
Subtotal		0	0	0	168	176	176	168	230	210	80	92	88	84	88	64	64	0	1688
TOTAL																			4044

Project Management Plan

Key Personnel

Dr. Matthew E. Kahn will serve as the Principal Investigator for the project. Dr. Kahn will co-ordinate working with the electric utility, and designing the Internet Survey. He will work with the research team to analyze the data that the survey generates when merged with the electric utility's data records. He has published papers on energy demand by residential households and gasoline and public transit demand. Kahn has studied the consequences of social networks in a variety of settings. This work has been published in the American Economic Review and just recently in a new book published by Princeton University Press.[2]

Dr. Kahn is a Professor at UCLA's Institute of the Environment, the Department of Economics and the Department of Public Policy. He is a Research Associate of the National Bureau of Economic Research (NBER). In fall 2008, he was named as a member of the Air Resources Board's Research Screening Committee. He is the author of the 2006 book, Green Cities: Urban Growth and the Environment (Brookings Institution Press). He received his Ph.D. degree in Economics from the University of Chicago in 1993. Before joining UCLA in January 2007, he served on the faculty at Columbia University and the Fletcher School at Tufts University. He has served as a Visiting Professor at Harvard and Stanford.

Dr. Frank A. Wolak will also serve as a Principal Investigator. Dr. Wolak is the Holbrook Working Professor of Commodity Price Studies in the Department of Economics at Stanford University. He will work on all of the project's tasks.

Frank Wolak has experience in conducting and evaluating energy experiments. In his 2006 paper titled Residential Customer Response to Real-Time Pricing: The Anaheim Critical-Peak Pricing Experiment, Wolak used an experimental design to evaluate how effective critical peak time pricing is for reducing household electricity consumption.[3] He is the Chairman of the Market Surveillance Committee of the California Independent System Operator for electricity supply industry in California. He is a visiting scholar at University of California Energy Institute and a Research Associate of the National Bureau of Economic Research (NBER). He received his Ph.D. degree in Economics from Harvard in 1985.

[2] http://press.princeton.edu/titles/8734.html
[3] ftp://zia.stanford.edu/pub/papers/anaheim_cpp.pdf

Explanation for Proposed Effort Levels

UCLA Post-Doctoral Student

We will need to recruit and hire a talented computer design expert to help build a sleek Internet website. For each household who is randomly assigned to the treatment group and chooses to fill out our 20 to 25 minute survey, this Internet visit will be the key "treatment" they will receive. With the exception of the household's monthly electricity bill, which will be provided by the electric company, all of the information we collect about the household will be generated during this website visit. To guarantee that we collect high quality data for the treatment group, we need to design an extremely high quality website. We anticipate that the person we select to build this website for us will work full time on this project for three months and that we will be working with this person. This programmer will also work closely with our graduate students to make sure that the survey is "user-friendly" and bug free. The website designer will also pre-test this site with UCLA and Stanford students to learn about their reactions to the experience of participating in the treatment. Once we have built this website, we will be able to use this again in the future when we run further experiments.

UCLA and Stanford graduate research assistants

This project will be highly data intensive and require a high level of co-ordination between the PIs, the electric utility and our graduate students. To facilitate our staying on our proposed time table, we will need the help of high quality graduate research assistants. During each stage of the project, these graduate assistants will play a number of key roles. At the start of the experiment, they will work with the website designer to build a high quality site. Once we have partnered with a California electric utility, the research assistants will work with the electric utility's information technology staff to arrange for specific data records on household monthly electricity consumption at the baseline to be made available to us. Under our guidance, the graduate students will analyze the baseline household electricity consumption differentials across households and use our survey based information that we collect to explain these differentials. Over time, we will observe how the treatment group and the control group differ with respect to their electricity consumption dynamics. Again, the research assistants will help us to analyze these data and to use the evaluation methods presented in section 3 above to test for the direct effects of the treatments and the peer effects.

We anticipate that considerable amounts of graduate research assistant time will be required to build the "peers" data base. We will use information on each treated household's residential street address to establish who its closest neighbors are. Our research assistants will need to aggregate this information and work with the electric utility's information technology people to collect the data on these neighbors' monthly electricity consumption. A similar time intensive task will be to take our survey respondents' self reported "friend list" and acquire their monthly electricity consumption from the electric utility.

After we have assembled our final longitudinal data set by household/month, we will work with the research assistants to formally evaluate the effectiveness of our various treatments.

Matthew E. Kahn

January 2009

UCLA
Institute of the Environment
La Kretz Hall, Suite 300
619 Charles E. Young Drive, East
Box 951496
Los Angeles, CA 90095
mkahn@ioe.ucla.edu
phone: 310-794-4904
fax: 310-825-9663
Webpage: mek1966.googlepages.com/home

Education

1988-1993. University of Chicago, Ph.D. in Economics.

1986-1987. London School of Economics, G.C. in Economic History.

1984-1988. Hamilton College, B.A. in Economics.

Employment

January 2007 Professor, UCLA Institute of the Environment, Department of Economics and the Department of Public Policy

2006-2007. Professor of Economics, Fletcher School and Department of Economics, Tufts University

2003-2004.. Visiting Associate Professor of Economics, Stanford University

2000-2006. Associate Professor of Economics, Fletcher School, Tufts University (tenure granted in May 2002)

2000. Visiting Fellow, Public Policy Institute of California

1999-2000. Associate Professor of Economics and International Affairs, Columbia University

1996-1998. Visiting Assistant Professor of Economics, Harvard University

1993-1999. Assistant Professor of Economics and International Affairs, Columbia University

Awards and Service

National Science Foundation Grant #9906165, The Concentration of Urban Poverty, 9/11/2000-8/31/2002. (Co-Principal Investigator with Ed Glaeser) $100,612

National Institute of Health grant R01 AG19637, 9/1/2002-8/31/2007. Senior Investigator, *Older Age Health and Longevity: A Long-Term View.* (Dora Costa is the Principal Investigator). Total direct and indirect $725,335

Environmental Stress, Social Networks, and Older Age Health and Mortality. NIH grant R01AG027960, Sept 1, 2007-Aug 31, 2012. Senior Investigator. (Dora Costa is the Principal Investigator). Total direct and indirect $1.2 million

Distinguished Fellow, Bing Center for Health Economics at the Rand Institute 2006.

Alfred P. Sloan Foundation Dissertation Fellowship 1993.

Associate Editor of Journal of Regional Science 2003-, special editor of the February 2007 issue of the Journal of Regional Science on environmental issues

Co-Editor of Journal of Regional Science 2007-2008.

Associate Editor of Regional Science and Urban Economics 2004-

Associate Editor of Journal of Urban Economics 2007-

Suggested back cover for the October 2003 and October 2006 issues of the Journal of Political Economy

Member of Environmental Economics Working Group and Cohort Studies Working Group at the National Bureau of Economic Research 2002-

Research Associate of the NBER Environmental and Energy Economics Group, 9/2007-

California Air Resources Board Research Screening Committee; October 2008

Books

Green Cities: Urban Growth and the Environment published September 1st 2006 by the Brookings Institution Press (see http://www.brookings.edu/press/books/greencities.htm), ISBN 978-0-8157-4816-8 , 2007 Planetizen Top Ten book of the year. Translated into Chinese by CIDEC in 2008.

Heroes and Cowards: The Social Face of War. (joint with Dora L. Costa) Princeton University Press, NBER Development of the American Economy Book Series, publication date December 2008. ISBN 978-0-691-13704-9 http://press.princeton.edu/titles/8734.html

Selected Relevant Publications

New Evidence on Trends in Vehicle Emissions. *Rand Journal of Economics*, Spring 1996 Vol. 27. No. 1, 183-196.

Measuring Environmental Demand: Evidence From California Voting Initiatives. (joint with John Matsusaka) *Journal of Law and Economics*. April 1997.

Quality of Life and the Environment. (joint with Joe Gyourko and Joe Tracy). Handbook of Regional and Urban Economics, edited by Paul Cheshire and Edwin Mills. Volume 3. North Holland Press. 1999.

The Environmental Impact of Suburbanization, *Journal of Policy Analysis and Management*, Fall 2000. 19(4), 569-586.

The Beneficiaries of Clean Air Act Legislation. *Regulation*. 24(1) 34-39. 2001.

Sprawl and Urban Growth (Chapter in the Handbook of Urban Economics Volume IV) joint with Edward Glaeser, edited by Vernon Henderson and J. Thisse. Volume 4. North Holland Press. 2004.

Surviving Andersonville: The Benefits of Social Networks in POW Camps (joint with Dora Costa) *American Economic Review*, September 2007.

Do Greens Drive Hummers? Environmental Ideology as a Determinant of Consumer Choice *Journal of Environmental Economics and Management*, September 2007.

Air Pollution Progress Despite Sprawl: The "Greening" of the Vehicle Fleet (Joint with Joel Schwartz) *Journal of Urban Economics*, 63(3) May 2008.

Regional Growth and Exposure to Nearby Coal Fired Power Plant Emissions, *Regional Science and Urban Economics*, forthcoming

Green Market Geography: The Spatial Clustering of Hybrids and LEED Registered Buildings (joint with Ryan Vaughn), *Contributions in Economic Policy*. Berkeley Electronic Press Journal (www.bepress.com)

Frank Anthony Wolak

Work Address:
Department of Economics
Stanford University
Stanford, CA 94305-6072
Phone: 650-723-3944
email: wolak@zia.stanford.edu
FAX: 650-725-5702
Homepage: http://www.stanford.edu/~wolak

Work Experience

September 1986 to Present
Holbrook Working Professor of Commodity Price Studies, Department of Economics, Stanford University

September 1989 to September 1990
National Fellow, Hoover Institution, Stanford University

June 1985 to August 1986
Postdoctoral Research Fellow, Department of Economics, Harvard University.

June 1980 to September 1981
Visiting Staff Member, Los Alamos National Laboratory, Economics Group, Los Alamos, NM.

Research Interests
Energy and Environmental Economics, Regulatory Economics, and Econometrics

Teaching Interests
Regulatory Economics, Energy and Environmental Economics, Econometric Theory

Professional Awards and Honors

Chairman, Market Surveillance Committee, California Electricity Industry Independent System Operator, April 1998-
Invited Speaker, EC2 Annual Conference, Marseille, 2005
Invited Speaker, Barcelona Economics Annual Conference, 2005
Keynote Speaker, ENCORE Annual Conference, Amsterdam, 2004
Invited Speaker, World Congress of Econometric Society, Seattle, 2000
Invited Lecture, Econometric Society European Meetings, Toulouse, France, 1997.
Research Associate, National Bureau of Economic Research, 1993-
Allen V. Cox Medal, 1991. Awarded annually to the Stanford University faculty member who has established a record of excellence directing undergraduate research over a number of years.
Faculty Research Fellow, National Bureau of Economic Research, 1991-1993

National Science Foundation, Presidential Young Investigator Award, 1990-1995
National Fellow, Hoover Institution, Stanford, CA, 1989-1990.
E.B. Earhart Foundation Graduate Fellowship, Harvard University, 1982-1984.

Education

June 1985, Ph.D., Economics, Harvard University, Cambridge, MA.
June 1984, S.M., Applied Mathematics, Harvard University, Cambridge, MA.
August 1980, M.A., Economics, University of New Mexico, Albuquerque, NM.
May 1979, B.A., Economics, Rice University, Houston, TX.

Professional Publications

Competition in Interregional Taxation: The Case of Western Coal, *Journal of Political Economy*, vol. 91, no. 3, 1983, 443-460 (with C.D. Kolstad).

Strategy and Market Structure in Western Coal Taxation, *Review of Economics and Statistics*, vol. LXVII, no. 2, 1985, 239-249 (with C.D. Kolstad).

A Capital-Labor-Energy Model of Fuel Demand in the Manufacturing Sector of Seven Major OECD Countries, *OPEC Review*, vol. X, no. 2, 1986, 179-214. (with C.D. Kolstad, A. Bopp, and R.E. Pendley).

Conjectural Variation and the Indeterminacy of Duopolistic Equilibria, *Canadian Journal of Economics*, vol. XIX, no. 4, 1986, 656-677 (with C.D. Kolstad).

An Exact Test for Multiple Equality and Inequality Constraints in the Linear Regression Model, *Journal of the American Statistical Association*, vol. 82, no. 399, 1987, 782-793.

Duality in Testing Multivariate Hypotheses, *Biometrika*, 1988, vol. 75, no. 3, 611-615.

Measuring Relative Market Power in the Western U.S. Coal Market Using Shapley Values, *Resources and Energy*, 1988, vol 10, 293-314 (with C.D. Kolstad).

Testing Inequality Constraints in Linear Econometric Models, *Journal of Econometrics*, 1989, vol. 41, no. 2, 205-236.

Local and Global Testing of Linear and Nonlinear Inequality Constraints in Nonlinear Econometric Models, *Econometric Theory*, 1989, vol. 5, no. 1, 1-35.

A Model of Homogeneous Input Demand under Price Uncertainty, *American Economic Review*, June 1991, 514-538 (with C.D. Kolstad).

The Local Nature of Hypothesis Tests Involving Nonlinear Inequality Constraints, *Econometrica*, July 1991, 981-996.

The Econometric Implications of Incentive Compatible Regulation, *Advances in Econometrics*, Volume 9, 1991, George F. Rhodes (ed), pp. 159-204 (with J.S. Feinstein).

The Effect of Domestic Antidumping Law in the Presence of a Foreign Monopolist, *Journal of International Economics*, vol. 32(3/4), 1992, 265-288 (with R.W. Staiger).

Collusive Pricing with Capacity Constraints in the Presence of Demand Uncertainty, *The Rand Journal of Economics*, Summer 1992, 203-220 (with R.W. Staiger).

Telecommunications Demand Modeling, *Information Economics and Policy*, 5, 1993, 179-195.

The Trade Effects of Antidumping Investigations: Theory and Evidence, in *Analytical and Negotiating Issues in the Global Trading System*, Alan W. Deardorff and Robert M. Stern (editors), University of Michigan Press: Ann Arbor, 1994, 231-261 (with R.W. Staiger).

A Procedure for Estimating the Unconditional HIV Infection Distribution and Its Variability, *The Journal of the Royal Statistical Society, Series C*, 43(4), 1994, 559-624 (with J. W. Hay).

Measuring Industry-Specific Protection: Antidumping in the United States, *Brookings Papers on Economic Activity, Microeconomics*, 1994, 51-118 (with R.W. Staiger).

An Econometric Analysis of the Asymmetric Information Regulator-Utility Interaction, *Annales d'Economie et de Statistique*, 34, 1994, 13-69.

Differences in the Uses and Effects of Antidumping Law Across Import Sources, in *The Political Economy of American Trade Policy*, Anne O. Krueger (editor), University of Chicago Press, 1996, 385-415 (with R.W. Staiger).

The Effect of Import Source on the Determinants and Impacts of Antidumping Suit Activity, in *The Political Economy of Trade Protection*, Anne O. Krueger (editor), University of Chicago Press, 1996, 85-93 (with R.W. Staiger).

Why Do Firms Simultaneously Participate in Spot and Contract Markets? Evidence from the United States Steam Coal Market, in *Agricultural Markets: Mechanisms, Failures and Regulation*, David Martimort (editor), North-Holland Publishing Company, 1996, 109-158.

Can Universal Service Survive in a Competitive Telecommunications Environment? Evidence from the Consumer Expenditure Survey, *Information Economics and Policy*, volume 8(3), 1996, 163-204.

Industry Structure and Regulation in the England and Wales Electricity Market, in *Pricing and Regulatory Innovation under Increasing Competition*, in Michael Crew (editor), Kluwer Academic Publishers, 1996, 65-90 (with R.H. Patrick).

The Consumption and Welfare Impacts of Competitive Telecommunications Supply: A Household-Level Analysis, *Brookings Papers of Economic Activity, Microeconomics*, 1997, 269-340.

Changes in the Household-Level Demand for Postal Delivery Services from 1986 to 1994, *in Managing Change in the Postal and Delivery Industries*, Michael Crew and Paul Kleindorfer (editors), Kluwer Academic Publishers, 1997, 162-191.

Electronic Substitution in the Household-Level Demand for Postal Delivery Services, *A Communications Cornucopia: Markle Foundation Essays on Information Policy*, Roger G. Noll and Monroe E. Price (editors) Brookings Institution Press, 1998, 421-447.

Price Cap Regulation in Newly Privatized Industries, *Oxford Energy Forum*, August 1998, 12-14.

Market Design and Price Behavior in Restructured Electricity Markets: An International Comparison, in *Competition Policy in the Asia Pacific Region, EASE Volume 8*, Takatoshi Ito and Anne Krueger (editors) University of Chicago Press, 1999, 79-134.

An Empirical Analysis of the Impact of Hedge Contracts on Bidding Behavior in a Competitive Electricity Market, *International Economic Journal*, Summer 2000, 1-40.

Identification and Estimation of Cost Functions Using Observed Bid Data: An Application to Electricity, *Advances in Econometrics: Theory and Applications, Eighth World Congress, Volume II*, Mathias Detwatripont, Lars Peter Hansen, and Stephen J. Turnovsky (editors), Cambridge University Press, 2003, 133-169.

Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market, *American Economic Review*, December 2002, 1367-1405 (with Severin Borenstein and James Bushell).

Measuring Unilateral Market Power in Wholesale Electricity Markets: The California Market 1998 to 2000, *American Economic Review*, May 2003, 425-430.

Diagnosing the California Electricity Crisis, *The Electricity Journal*, August/September 2003, 11-37.

Regulating Wholesale Electricity Markets in the Aftermath of the California Crisis, *The Electricity Journal*, August/September 2003, 50-55.

Managing Unilateral Market Power in Wholesale Electricity, in *The Pros and Cons of Antitrust in Deregulated Markets*, edited by Mats Bergman, Swedish Competition Authority, 2004, 78-101.

Lessons from the California Electricity Crisis, in *Electricity Deregulation*, edited by James M. Griffin and Steven L. Puller, University of Chicago Press, 2005, 145-181.

Unilateral Market Power in Wholesale Electricity Markets, *CESifo DICE Report*, Volume 2, 2006, 10-15.

Structural Econometric Modeling: Rationales and Example from Industrial Organization, *Handbook of Econometrics*, Volume 6A, (edited by James J. Heckman and Edward E. Leamer), 2007, 4277-4415 (with Peter C. Reiss).

Quantifying the Supply-Side Benefits from Forward Contracting in Wholesale Electricity Markets, *Journal of Applied Econometrics*, volume 22, 2007, 1179-1209.

Limiting the Potential Downside of Competitive Wholesale Electricity Markets (in Spainish), *Energia y Regulacion*, (edited by Jose Luis Garcia Delgado and Juan Carlos Jimenez) Thomson Civitas Publishing, 2007, 139-153.

The Changes in Household Demand for Postal Delivery Services: 1986-2000, *Journal of Econometrics*, forthcoming, 2008.

When Does Value-Based Pricing by a Regulated Firm Increase Welfare? The Pricing of Respositional Notes for Use in Postal Delivery, *Journal of Competition Law and Economics*, forthcoming, 2008.

Merger Analysis in Restructured Electricity Supply Industries: The Proposed PSEG and Exelon Merger (2006), forthcoming in *The Antitrust Revolution: Economics Competition and Policy*, edited by John Kwoka and Lawrence White, Oxford University Press: New York, 2008.

Regulating Competition in Wholesale Electricity Supply, *NBER Regulation Policy Volume*, (edited by Nancy Rose) forthcoming, 2008.

Public Utility Pricing and Finance." The New Palgrave Dictionary of Economics. Second Edition. Eds. Steven N. Durlauf and Lawrence E. Blume. Palgrave Macmillan, 2008. The New Palgrave Dictionary of Economics Online. Palgrave Macmillan. 03 May 2008.

Reforming the Indian Electricity Supply Industry, in *Sustaining India's Growth Miracle*, edited by Jagdish N. Bhagwati and Charles W. Calomiris, Columbia Business School Publishing, 2008, 115-155.

Working Papers (Available at http://www.stanford.edu/~wolak)

Government Reports

Electric Utility Oil and Gas Use in the Eighties, Los Alamos National Laboratory report LA-9319-MS, Los Alamos, NM (April 1982, with C.D. Kolstad, D.S. Abbey, A.J. Martinez, D.S. Williams, and M.K. Yeamans).

Documentation of the Los Alamos Coal and Utility Modeling System, Version 3.0, Los Alamos National Laboratory report LA-8863-MS, Los Alamos, NM (May 1981, with R.L. Bivins, C.D. Kolstad, and M.L. Stein).

Projecting the Costs of AIDS and ARC in the United States, Final Report for Grant No. HS 06092-01 to the Agency for Health Care Policy and Research, U.S. Department of Health and Human Services, Public Health Service (May 1990, with J.W. Hay and D.H. Osmond).

Congressional Testimony

Senate Committee on Governmental Affairs, June 13, 2001, On Role of Federal Energy Regulatory Commission in Functioning of California Electricity Market

House Committee on Financial Services, June 20, 2001, On California Energy Crisis and Its Implications for Long-Term Energy Policy *Senate Committee on Commerce, Science and Transportation*, May 15, 2002, On Enron's Role in California Energy Crisis

Senate Committee on Government Affairs, November 12, 2002, On the Lessons that Should Be Learned About Regulating Energy Markets from the California Electricity Crisis and the Enron Bankruptcy

House Committee on Oversight and Government Reform, February 28, 2008, Implementing a Modern System of Regulation for the Postal Service under the Postal Accountability and Enhancement Act

Newspaper Opinion/Editorial Pieces

"Will FERC See the Light on the Law?" (Los Angeles Times, 4/30/01).

Want 10,000 megawatts? Use Variable Power Pricing" (San Jose Mercury News, May 4, 2001).

FERC Fixes Have Fallen Short" (San Jose Mercury News, June 20, 2001).

"$9 Billion Rebate Should Be Just the Beginning," (North County Times, July 11, 2001).

"Is Price Gouging Really the Problem?" (San Diego Union Tribune, July 27, 2001)

FERC's duty is clear: Order energy refunds for California" (San Jose Mercury News, March 28, 2003)

"Upgrading Power Grid Could Lead to Lower Prices" (San Jose Mercury News, August 28, 2003)

"Driving Home Some Reasons for Hike in State Gas Prices?" (San Jose Mercury News, April 25, 2004)

Research Grants

Winter 1989 to Spring 1990

Econometric Models of the Regulatory Rate-Setting Process, Center for Economic Policy Research, Stanford University, $20,000.

Summer 1990 to Spring 1991
Regulation of Water Delivery in California, Stanford University Office of Technology Licensing Research Incentive Fund, $20,750.

Summer 1990 to Summer 1991
Empirical Studies of Japanese Industry, CEPR Program on the Japanese Economy, $17,000.

Summer 1990 to Summer 1996
Empirical Studies of Firm and Industry Behavior, 5-Year Presidential Young Investigator Award, National
Science Foundation, $312,500.

Summer 1993 to Winter 1997

The Trade Effects of Antidumping Investigations, 3-Year National Science Foundation, $165,000 (with R.W. Staiger).

Summer 1994 to Spring 1996

Studies of Competition and Demand in Telecommunications, Postal Delivery and Cable Television Markets, Markle Foundation, $75,000.

Summer 1994 to Summer 1996
Measuring the Structure of Consumer Demand for Electricity Using Real-Time Pricing Data from the United Kingdom Electricity Market, Electric Power Research Institute, $30,000.

Summer 1995 to Summer 1996

A Comparison of Statistical Forecasting Models for Real-Time Electricity Price, Electric Power Research Institute, $35,000.

Summer 1997 to Summer 2001

Empirical Studies of Regulated Industries, National Science Foundation, 3-Year Grant, National Science Foundation, $212,612

Autumn 2001 to Summer 2002

Research on California Energy Policy, Energy Foundation, 1-Year Grant, $65,000.

Summer 2004 to Summer 2007

Empirical Methods for Measuring and Improving Market Performance in Network Industries, 3-Year Grant, National Science Foundation, $156,000

Professional Service

Member, Economics Graduate Fellowship Panel, National Science Foundation, 2007
Member, Electric Power Networks Efficiency and Security Panel, National Science Foundation, 2002-2003
Member, Economics Panel, National Science Foundation, 1998-2000
Associate Editor, *The Journal of Economic Literature*, 1994-1998
Associate Editor, *Journal of Econometrics*, 1994-2002
Associate Editor, *Journal of Industrial Economics*, 1995-2002
Associate Editor, *Journal of Business and Economic Statistics*, 1995-1998
Program Committee Member, 1995 North American Winter Meeting of the Econometric Society.
Program Committee Member, 1996 American Economic Association Meetings
Program Committee Member, 1997 North American Summer Meeting of the Econometric Society
Program Committee Member, 2003 American Economic Association Meetings

EXHIBIT B

BUDGET DETAIL AND PAYMENT PROVISIONS

1. Invoicing

A. For services satisf actorily rendered in accordance with this agreement and upon receipt and approval of the invoices which properly detail all charges the Air Resources Board agrees to compensate the Regents of the University of California, Los Angeles for actual expenditures incurred in accordance with the rates specified herein or attached hereto.

B. Invoices shall inclu de the Agreement Number and shall be submitted in triplicate not more frequently than quarterly in arrears to Ms. Emma Plasencia at the address stated in Exhibit A, Article 2.

C. Budget Flexibility: Subject to the prior review and approval of the contract manager, line item shifts of up to $25,000 or ten percent of the annual contract total, whichever is less, may be made up to a cumulative maximum of $25,000 or 10%, whichever is less, for all line item shifts over the life of the contract. There must be a substantial business justification for any shifts made. Fund shifts which increase Indirect, Overhead or General Expense line items are prohibited. Line item shifts may be proposed/requested by either the State or the University in writing and must not increase or decrease the total contract amount allocated. Any line item shifts must be approved in writing by the Division Chief of the Research Division, or his or her designee, and must be sent to the Contracts Section within 10 days of approval for inclusion in the contract folder. If the contract is formally amended, any line item shifts agreed to by the parties must be included in the amendment.

2. Budget Contingency Clause

A. It is m utually agreed that if the Budget Act of the current year and/or any subsequent years covered under this Agreement does not appropriate sufficient funds for the program, this Agreement shall be of no further force and effect. In this event, the State shall have no liability to pay any funds whatsoever to Contractor or to furnish any other considerations under this Agreement and Contractor shall not be obligated to perform any provisions of this Agreement.

B. If funding for any fiscal year is reduced or deleted by the Budget Act for purposes of this program, the State shall have the option to either cancel this Agreement with no liability occurring to the State, or offer an agreement amendment to Contractor to reflect the reduced amount.

3. Payment

A. Costs for this Agreement shall be computed in accordance with State Administrative Manual Sections 8752 and 8752.1.

B. Nothing herei n contained shall preclude advance payments pursuant to Article 1, Chapter 3, Part 1, Division 3, Title 2 of the Government Code of the State of California.

C. ARB shall withhold payment equal to ten percent of the total Agreement cost until completion of all work and submission to ARB by University of a final report (including computer diskette copy) approved in accordance with Exhibit F, by ARB. It is University's responsibility to submit an invoice in triplicate with the revised final report for ten percent withheld.

D. University will be paid for the payment period completed upon receipt, by ARB, of an invoice and progress report satisfying the requirements of this Agreement. The invoice and progress report must be deemed by ARB to reflect reasonable work performed in accordance with the Agreement.

E. Th e amount to be paid to University under this Agreement includes all sales and use taxes incurred pursuant to this Agreement. University shall not receive additional compensation for reimbursement of such taxes and shall not decrease work to compensate therefore.

Budget Submittal Form

This form is supplied for presenting budget detail to the Air Resources Board.

PLEASE TYPE OR PRINT:

Title of Proposal: A Field Experiment to Assess the Impact of Information Provision on Household Electricity Consumption

Total Budget Requested: $173,934

Period Covered (months): 22

University: The Regents of the University of California Los Angeles campus

Address: Office of Contract & Grant Administration; 11000 Kinross Ave, Suite 102; Los Angeles, CA 90024-1406

Name of person authorized to bind this bid: Martha Hansen

Title: Sr. Contract and Grant Officer

Phone: 310.794.0236

Signature of person authorized to bind this bid: Martha Hansen

Budget Summary

Budget details must be supplied on pages 3-11 and on additional pages if necessary.
Instructions and definitions of terms are provided in Attachment 1 of the Guidelines for Proposals.

NOTE: Totals in categories in this summary are automatically updated from pages 3-11 when using Excel file.

Direct Costs		
1.	Labor & Employee Fringe Benefits	$34,848
2.	Subcontractor(s)/Consultant(s)	$56,433
3.	Equipment	$0
4.	Travel & Subsistence	$0
5.	Electronic Data Processing	$0
6.	Photocopying & Printing	$0
7.	Mail, Telephone, and Fax	$0
8.	Materials & Supplies	$0
9.	Analyses	$0
10.	Miscellaneous	$71,393
	Total Direct Cost	$162,674

Indirect Costs		
11.	Overhead (10%)	$11,259
	Total Indirect Cost	$11,259

Total Direct and Indirect Cost:	$173,934

Budget Detail
I. Direct Costs

1a. Labor Charges for Universities and Other State Agencies

Note: Total Salary Requested cell is automatically calculated when using Excel.

	Individual's Name	Work Title	Mo. Salary	Est. Months	% of Effort or % of Salary	Total Salary Requested
A.	Matthew Kahn	PI	$0.00	12.00	20-50%	$0
B.	TBN	GSR	$3,229.00	6.00	25.00%	$4,844
C.	TBN	GSR	$3,229.00	6.00	25.00%	$4,844
D.	TBN	Postdoc	$6,740.00	3.00	100.00%	$20,220
E.						$0
F.						$0
G.						$0
H.						$0
I.						$0

(use additional page if necessary)

Subtotal: $29,907

Cost justifications. Describe exactly why each individual listed in the Budget Detail is needed in this project (i.e., their role in the project), why this particular person was chosen for this role, and why their proposed level of effort is necessary. Describe, for each position listed, why the specified rate is reasonable or competitive. (Use additional page if necessary).

Principal Investigator: Matthew Kahn, will provide 10% effort on this study. He is not asking for funding from the ARB on this project.

Graduate Student Researchers: Two GSR's (level 3) will be hired over a 10-month period at 25% time each. Level 3 GSR's are the mininum level the Institute of the Environment pays their graduate students. This project will be highly data intensive and require a high level of co-ordination between the PIs, the electric utility and our graduate students. To facilitate our staying on our proposed time table, we will need the help of high quality graduate research assistants. During the stages of the project, these graduate assistants will play a number of key roles. At the start of the experiment, they will work with the website designer to build a high quality site. Once we have partnered with a California electric utility, the research assistants will work with the electric utility's information technology staff to arrange for specific data records on household monthly electricity consumption at the baseline to be made available to us. Under our guidance, the graduate students will analyze the baseline household electricity consumption differentials across households and use our survey based **(to be continued on Page 3A)**

Budget Justification (continued)

Labor:
Graduate Student Researchers:

information that we collect to explain these differentials. Over time, we will observe how the treatment group and the control group differ with respect to their electricity consumption dynamics. Again, the research assistants will help us to analyze these data and to use the evaluation methods presented in section 3 to test for direct effects of the treatments and the peer effects.

We anticipate that considerable amounts of graduate research assistant time will be required to build the "peers" data base. We will use information on each treated household's residential address to establish who its closest neighbors are. Our research assistants will need to aggregate this information and work with the electric utility's information technology people to collect the data on these neighbors' monthly electricity consumption. A similar time intensive task will be to take our survey respondents' self reported "friend list" and acquire their monthly electricity consumption from the electric utility.

After we have assembled our final longitudinal data set by household/month, we will work with the research assistants to formally evaluate the effectiveness of our various treatments.

Postdoc: A postdoc will be hired for the 3-month period required for Task 3 to write and post the project survey. We will need to recruit and hire a talented computer design expert to help build a sleek Internet website. For each household who is randomly assigned to the treatment group and chooses to fill out our 20 to 25 minute survey, this Internet visit will be the key "treatment" they will receive. With the exception of the household's monthly electricity bill, which will be provided by the electric company, all of the information we collect about the household will be generated during this website visit. To guarantee that we collect high quality data and that provide a useful information treatment for the households in the treatment group, we need to design an extremely high quality website. We anticipate that the person we select to build this website for us will work full time on this project for three months and that we will be working with this person and our graduate students will also be working with this person to make sure that the survey is "user-friendly" and bug free. The website designer will also pre-test this site with UCLA and Stanford students to learn about their reactions to the experience of participating in the treatment. Once we have built this website, we will be able to use this again in the future if we run further experiments.

1b. Fringe Benefits

Note: COST cells automatically calculate when using Excel file

	Individual's Name	BASE ($)	RATE (%)	COST
A.	Matthew Kahn	$0.00	0.00%	$0
B.	TBN - GSR	$4,843.50	3.00%	$145
C.	TBN - GSR	$4,843.50	3.00%	$145
D.	TBN - Postdoc	$20,220.00	23.00%	$4,651
E.				$0
F.				$0
G.				$0
H.				$0
I.				$0

(use additional page if necessary)

Subtotal: $4,941

Cost justifications. Provide the Basis for the Fringe Benefit Rates. (Use additional page if necessary).

For FY 09-10 UCLA Benefit rate for students is 3% and Postdocs is 24%.

2. Subcontractors & Consultants

List all subcontractors and consultants. **Also submit separate Budget Submittal Form for each subcontractor and consultant.**

	Subcontractor or consultant	Cost
A.	Stanford University - PI Frank Wolak	$56,433
B.		
C.		
D.		

(use additional page if necessary)

Subtotal: $56,433

Cost justifications. Describe exactly why each subcontractor is needed in this project (i.e., their role in the project). Describe, for each subcontractor, why the specified rate is reasonable or competitive. (Use additional page if necessary).

The co-PI, Frank Wolak is a professor at Stanford University. He will will provide 20-50% effort on this study. He is not asking for funding from the ARB on this project but will directly supervise the Research Assistants at Stanford. Cost of Stanford's budget is for two Research Assistants for 6 months (stipend, tuition, and health fees).

3. Equipment (Itemize)

	Item	Cost
A.		
B.		
C.		
D.		

Subtotal: $0

Cost justifications. Describe exactly why each listed equipment item is needed in this project, and why the cost is reasonable. (Use additional page if necessary).

(Refer to Exhibit E, page 19)

4. **Travel and Subsistence (Itemize). Use State Rates (Appendix IV). NO FOREIGN TRAVEL ALLOWED.**

	Description	Cost
A.	Air transportation	
B.	Ground transportation	
C.	Per diem or subsistence	
D.	Other (Lodging & Parking)	

Subtotal: $0

Cost justifications. Describe the purpose and duration of each trip and explain why the travel is necessary. (Use additional page if necessary).

5. **Electronic Data Processing (Itemize)**

	Description	Cost
A.		
B.		
C.		
D.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

6. Photocopying & Printing (Itemize)

	Description of product	Cost
A.		
B.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

7. Mail, Telephone & Fax (Itemize)

	Item	Cost
A.		
B.		
C.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

8. **Materials & Supplies** (itemize)

	Item	Cost
A.		
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		

Subtotal:	**$0**

Cost justifications. Describe exactly why each item listed above is needed in this project. Explain why the proposed cost is reasonable. (Use additional page if necessary).

9. Analyses (Itemize)

	Description	Cost
A.		
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		

Subtotal:	**$0**

Cost justifications. Describe the purpose of each different analysis and explain why it is needed in this project. Explain why the proposed rate is reasonable. (Use additional page if necessary).

10. Miscellaneous (Itemize)

	Item	Cost
A.	Electric Company	$52,500
B.	UCLA Graduate Student Researcher Fees	$18,648
C.	TIF Charges	$245
D.		

Subtotal: $71,393

Cost justifications. Justify all costs not included in the categories above. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

Payments made by the electric company at $35 per participant will be reimbursed by this study. Based on 4,000 households receiving inserts the PI's are hopeful that 37.5% (or 1,500) will complete the survey.

Based on the current 08-09 Graduate fees of $3,108/quarter. Request is for 3 quarters for 2 graduate students.

Technology Infrastructure Fee (TIF) mandatory university charged calculated on FTE and billed at the FAU level based on actual monthly FTE derived from payroll data of $40.75 per FTE, per month.

Total Direct Costs (add subtotals for categories 1-10): $162,374

II. Indirect Costs

11. Overhead and Other Indirect Costs

	Base (Salaries, total direct costs, etc.) ($)	Rate (%)	Cost
A.	$112,593.21	10.00%	$11,259
B.			$0
C.			$0

Subtotal: $11,259

Total Indirect Cost: $11,259

Total Project Cost: $173,934

Budget Submittal Form

This form is supplied for presenting budget detail to the Air Resources Board.

PLEASE TYPE OR PRINT:

Title of Proposal: A Field Experiment to Assess the Impact of Information Provision on Household Electricity Consumption

Total Budget Requested: $56,433

Period Covered (months): 17

University: Stanford University

Address: Office of Sponsored Research; 340 Panama Street; Stanford, CA 94305-6203

Name of person authorized to bind this bid: Csilla Csaplar

Title: Administrator, Contract & Grant Officer

Phone: 650.498.6877

Signature of person authorized to bind this bid:

Budget Summary

Budget details must be supplied on pages 3-11 and on additional pages if necessary.
Instructions and definitions of terms are provided in Attachment 1 of the Guidelines for Proposals.

NOTE: Totals of calendar hours/months are automatically updated from pages 3-11 when using Excel.

Direct Costs		
1.	Labor & Employee Fringe Benefits	$30,677
2.	Subcontractor(s)/Consultant(s)	$0
3.	Equipment	$0
4.	Travel & Subsistence	$0
5.	Electronic Data Processing	$0
6.	Photocopying & Printing	$0
7.	Mail, Telephone, and Fax	$0
8.	Materials & Supplies	$0
9.	Analyses	$0
10.	Miscellaneous	$22,688
	Total Direct Cost	$53,365

Indirect Costs		
11.	Overhead (10%)	$3,068
	Total Indirect Cost	$3,068

Total Direct and Indirect Cost:	$56,433

Budget Detail

I. Direct Costs

1a. Labor Charges for Universities and Other State Agencies

Note: Total Salary Requested cells automatically calculate when using Excel file.

	Individual's Name	Work Title	Mo. Salary	Est. Months	% of Effort or % of Salary	Total Salary Requested
A.	Frank Wolak	PI	$0.00	17.00	20-50%	$0
B.	TBN	Research Assistant	$4,888.00	6.00	50.00%	$14,664
C.	TBN	Research Assistant	$4,888.00	6.00	50.00%	$14,664
D.						$0
E.						$0
F.						$0
G.						$0
H.						$0
I.						$0

(use additional page if necessary)

Subtotal: $29,328

Cost justifications. Describe exactly why each individual listed in the Budget Detail is needed in this project (i.e., their role in the project), why this particular person was chosen for this role, and why their proposed level of effort is necessary. Describe, for each position listed, why the specified rate is reasonable or competitive. (Use additional page if necessary).

Principal Investigator: Frank Wolak, will provide 20-50% effort on this study. He is not asking for funding from the ARB on this project but will directly supervise the Research Assistants.

Research Assistants: Two RA's will be hired over a 6-month period at 50% time each. 50% RA's will be paid a stipend of $7332/ quarter in Academic Year 2009-10.

1b. Fringe Benefits

Note: cost will automatically calculate when using Excel

	Individual's Name	BASE ($)	RATE (%)	COST
A.	Frank Wolak	$0.00	0.00%	$0
B.	TBN - RA	$14,664.00	4.60%	$675
C.	TBN - RA	$14,664.00	4.60%	$675
D.				$0
E.				$0
F.				$0
G.				$0
H.				$0
I.				$0
(use additional page if necessary)				

Subtotal: $1,349

Cost justifications. Provide the Basis for the Fringe Benefit Rates. (Use additional page if necessary).

Research Assistants: Two RA's will be hired over a 6-month period at 50% time each. 50% RA'swill be paid a stipend of $7332/ quarter in Academic Year 2009-10; the stipend automatically incurs a fringe benefit rate based on university norms (4.6%).

2. Subcontractors & Consultants

List all subcontractors and consultants. Also submit separate Budget Submittal Form for each subcontractor and consultant.

Subcontractor or consultant	Cost
A.	
B.	
C.	
D.	

(use additional page if necessary)

Subtotal: $0

Cost justifications. Describe exactly why each subcontractor is needed in this project (i.e., their role in the project). Describe, for each subcontractor, why the specified rate is reasonable or competitive. (Use additional page if necessary).

3. Equipment (Itemize)

Item	Cost
A.	
B.	
C.	
D.	

Subtotal: $0

Cost justifications. Describe exactly why each listed equipment item is needed in this project, and why the cost is reasonable. (Use additional page if necessary).

(Refer to Exhibit E, page 19)

4. Travel and Subsistence (Itemize). Use State Rates (Appendix IV). NO FOREIGN TRAVEL ALLOWED.

	Description	Cost
A.	Air transportation	
B.	Ground transportation	
C.	Per diem or subsistence	
D.	Other (Lodging & Parking)	

Subtotal: $0

Cost justifications. Describe the purpose and duration of each trip and explain why the travel is necessary. (Use additional page if necessary).

5. Electronic Data Processing (Itemize)

	Description	Cost
A.		
B.		
C.		
D.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

6. Photocopying & Printing (Itemize)

	Description of product	Cost
A.		
B.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

7. Mail, Telephone & Fax (Itemize)

	Item	Cost
A.		
B.		
C.		

Subtotal: $0

Cost justifications. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

8. Materials & Supplies (Itemize)

	Item	Cost
A.		
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		

Subtotal:	**$0**

Cost justifications. Describe exactly why each item listed above is needed in this project. Explain why the proposed cost is reasonable. (Use additional page if necessary).

9. Analyses (Itemize)

	Description	Cost
A.		
B.		
C.		
D.		
E.		
F.		
G.		
H.		
I.		

Subtotal:	**$0**

Cost justifications. Describe the purpose of each different analysis and explain why it is needed in this project. Explain why the proposed rate is reasonable. (Use additional page if necessary).

10. Miscellaneous (Itemize)

	Item	Cost
A.	Stanford RA Tuition	$21,116
B.	Stanford Health Surcharge	$1,572
C.		
D.		

Subtotal: $22,688

Cost justifications. Justify all costs not included in the categories above. Explain the need for the expenditure and the basis for the costs. (Use additional page if necessary).

Based on the Graduate fees of $5279/quarter for Academic Year 2009-10. Request is for 2 quarters for 2 graduate students.

Based on the student health surcharge of $393/quarter for Academic Year 2009-10. Request is for 2 standard quarters and one summer for 2 graduate students.

Total Direct Costs (add sub-totals for categories 1-10) $53,382

II. Indirect Costs

11. Overhead and Other Indirect Costs

	Base (Salaries, total direct costs, etc.) ($)	Rate (%)	Cost
A.	$30,677.09	10.00%	$3,068
B.			$0
C.			$0

Subtotal: $3,068

Total Indirect Cost: $3,068

Total Project Cost: $56,433

EXHIBIT D

SPECIAL TERMS AND CONDITIONS

1. Termination

A. This Agreement may be canceled at any time by either party, upon thirty (30) days written notice to the other party.

B. In the case of early termination, the performing agency will submit an invoice in triplicate and a report in triplicate covering services to termination date, following the invoice and progress report requirements of this Agreement. A copy and description of any data collected up to termination date will also be provided to ARB.

C. Upon receipt of the invoice, progress report, and data, a final payment will be made to the performing agency. This payment shall be for all ARB-approved, actually incurred costs in accordance with Exhibits A and B, and shall include labor, and materials purchased or utilized (including all noncancellable commitments) to termination date, and pro rata indirect costs as specified in the proposal budget.

2. Disputes

A. ARB reserves the right to issue an order to stop work in the event that a dispute should arise, or in the event that the ARB gives the performing agency a notice that this Agreement will be terminated. The stop-work order will be in effect until the dispute has been resolved or this Agreement has been terminated.

B. Any dispute concerning a question of fact arising under the terms of this Agreement which is not disposed of within a reasonable period of time by agency employees normally responsible for the administration of this agreement, shall be brought to the attention of the Executive Officer or designated representative of each agency for joint resolution.

3. Amendments

ARB reserves the right to amend this agreement for additional time and/or additional funding.

EXHIBIT E
ADDITIONAL PROVISIONS

1. Equipment Provisions

A. Equipment is defined as movable articles of nonexpendable property that meet the following requirements:

1. have a normal useful life (including extended life due to repairs) of at least one year;
2. have a unit acquisition cost of at least $5,000 for other than land and structures (for example, identical assets costing $3,000 each for a $12,000 total would not meet the requirements); and
3. be used to conduct work under this contract, and/or
4. any and all electronic data processing (EDP) equipment used to conduct work under this contract.

B. The cost of equipment includes the purchase price plus all costs to acquire, install, and prepare equipment for its intended use.

C. The ARB reserves the right to purchase total equipment whose cost is greater than $25,000 and any and all EDP equipment for this contract, through the State procurement process. Contractor's proposed cost of this equipment will be deducted from the total amount payable to the Contractor. The equipment provided by ARB will be equivalent to Contractor's specifications, as described in Contractor's proposal.

D. In the event Contractor purchases with ARB funds, procures, uses, or otherwise takes possession of equipment owned by ARB to perform work under this contract, title to such equipment shall remain with ARB and such equipment shall become ARB's equipment upon delivery thereof into the Contractor's control or possession.

E. Contractor shall obtain written approval from ARB prior to the purchase of equipment that is not specifically identified and listed in the approved budget and which is valued at more than $5,000. The contract funding shall be adjusted for any equipment or supplies furnished by ARB.

F. ARB reserves the right to full and adequate access to ARB equipment.

G. Contractor shall maintain and administer a program for the utilization, maintenance, repair, protection, and preservation of ARB equipment, whether acquired from the ARB or purchased with ARB funds from a third party, so as to assure its full availability and usefulness for performance of this contract or as long as this equipment remains in the control or possession of the Contractor. The Contractor will install upon each item of equipment a tag identifying the equipment as belonging to the ARB and will maintain location records of all

equipment. The Contractor shall take steps to comply with all appropriate directions or instructions that the ARB may prescribe for the protection of ARB equipment.

H. Contractor shall provide to ARB, with the final invoice, a final equipment inventory. The final invoice shall contain an itemization of equipment purchased with ARB funds or procured through the State procurement process, including the type of equipment, manufacturer, serial number, and cost. All ARB equipment shall be returned to the ARB at ARB's expense in full operating condition upon termination of this contract, unless ARB approves a different disposition in writing. Disposition of the equipment shall be in accordance with the instructions from ARB, to be issued after receipt of the final inventory.

2. **Reports and Data Compilations**

A. ***With respect to each invoice period, University shall forward to the ARB Contract Administrator, one (1) electronic copy of the progress report and mail one (1) copy of the progress report along with each invoice. (Do not use Express Mail). When emailing the progress report, the "subject line" should state the contract number and the billing period. Each progress report will begin with the following disclaimer:***

> *The statements and conclusions in this report are those of the University and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.*

B. Each progress report will also include:

1. A brief narrative account of project tasks completed or partially completed since the last progress report;

2. A brief discussion of problems encountered during the reporting period and how they were or are proposed to be resolved;

3. A brief discussion of work planned, by project task, before the next progress report; and

4. A graph or table showing allocation of the budget and amount used to date.

5. A graph or table showing percent of work completion for each task.

C. If the project is behind schedule, the progress report must contain an explanation of reasons and how the University plans to resume the schedule.

D. Six months prior to Agreement termination date, University will deliver to ARB twenty (20) bound copies of a draft final report. The reports may be stapled or spiral bound, depending on size. The draft final report will conform to Exhibit F.

E. Within forty-five (45) days of receipt of ARB's comments on the draft Final Report (Exhibit F), University will deliver to ARB's Contract Manager two (2) copies of the Final Report incorporating all reasonable alterations and additions requested by ARB. Upon approval of the amended final report approved by ARB in accordance to Exhibit F, University will within two (2) weeks, deliver to ARB two (2) camera ready UNBOUND originals of a Final Report incorporating all final alterations and additions. The final report will conform to the Contract Final Report Format, Exhibit F.

F. Together with the final report, University will deliver a copy of the report on diskette/CD, using any common word processing software (please specify the software used) and a set of all data compilations as specified by the ARB Contract Manager.

G. University's obligation under this Agreement shall be deemed discharged only upon submittal to ARB of an acceptable final report in accordance to Exhibit F, report diskette/CD, all required data compilations, and any other project deliverables.

H. Prior to completion of this Agreement, University shall be entitled to release or make available reports, information, or other data prepared or assembled by it pursuant to this Agreement, in scientific journals and other publications and at scientific meetings, provided however, that a copy of the publication be submitted to ARB for review and comment 45 days prior to such publication. Further, University shall place the disclaimer statement in a conspicuous place on all such reports or publications. Health related reports should include an acknowledgment to the late Dr. Friedman. Nothing in this provision shall be construed to limit the right of State to release information obtained from the University or to publish reports, information, or data in State publications.

3. **Copyrightable Materials**

In recognition of the policy of ARB and University to promote and safeguard free and open inquiry by faculty, students and the members of the public and in furtherance of such policy, both parties agree to the following with respect to rights in data and copyrights under this Agreement:

A. The term "Subject Data" shall mean all original and raw research data, notes, computer programs, writings, sound recordings, pictorial

reproductions, drawings or other graphical representations, and works of any similar nature, produced by University in performance of this Agreement, but specifically excluding "Reports," as defined in this Agreement. Subject Data also excludes financial reports, cost analyses, and similar information incidental to contract administration.

B. The term "Reports" shall have the meaning assigned to it in this Exhibit F of this Agreement.

C. Ownership of all Subject Data and copyrights arising from Subject Data shall be vested in University while ownership of all Reports and copyrights arising from the Reports delivered under this Agreement shall be vested in ARB. University agrees to make available to the public for public benefit, to the extent the University shall have the legal right to do so, without license or fee, any scholarly articles which are published from the Subject Data.

D. Nothing in this exhibit or Agreement shall be construed to limit the right of University faculty, students or staff to publish the Subject Data in the form of scholarly articles in academic journals nor to affect, abrogate or limit the right of University faculty, staff or students to make use of the Subject Data.

4. Travel & Per Diem

A. Any reimbursement for necessary travel and per diem shall be at the University's approved travel rates.

B. No foreign travel shall be reimbursed unless prior written authorization is obtained from ARB.

5. Meetings

A. Initial meeting. Before work on the contract begins, the Principal Investigator and key personnel will meet with the ARB Contract Manager and other staff to discuss the overall plan, details of performing the tasks, the project schedule, items related to personnel or changes in personnel, and any issues that may need to be resolved before work can begin.

B. Progress review meetings. The Principal Investigator and appropriate members of his or her staff will meet with ARB's Contract Manager at quarterly intervals to discuss the progress of the project. This meeting may be conducted by phone.

C. Technical Seminar. The Contractor will present the results of the project to ARB staff and a possible webcast at a seminar at ARB facilities in Sacramento or El Monte.

6. Confidentiality

A. It is understood that in the course of carrying out this Agreement, State may wish to provide University with proprietary or confidential information of State (Proprietary Information). University agrees to use its best efforts to hold proprietary information in confidence and shall return it to State upon the completion of the project.

B. This obligation shall apply only to proprietary information that is designated or identified as such in writing by State prior to the disclosure thereof. All proprietary information shall be sent only to the Principal Investigator. Moreover, this obligation shall not apply to any proprietary information which: a) is or becomes publicly known through no wrongful or negligent act on the part of University; b) is already known to University at the time of disclosure; c) independently developed by University without breach of this agreement; or d) is generally disclosed to third parties by State without similar restrictions on such third parties.

7. Studies Involving Human or Animal Subjects

A copy of the Institutional Review Board (IRB) approval must be submitted to ARB upon receipt by the investigator.

EXHIBIT F

RESEARCH FINAL REPORT FORMAT

The research contract Final Report (Report) is as important to the contract as the research itself. The Report is a record of the project and its results, and is used in several ways. Therefore, the Report must be well organized and contain certain specific information. The ARB's Research Screening Committee (RSC) reviews all draft Final Reports, paying special attention to the Abstract and Executive Summary. If the RSC finds that the Report does not fulfill the requirements stated in this Appendix, the document will not be approved for release, and final payment for the work completed may be withheld. This Appendix outlines the requirements that must be met when producing the Report.

Note: In partial fulfillment of the Final Report requirements, the Contractor shall submit a copy of the Report on a CD in PDF format and in a word-processing format, preferably in Word - Version 6.0 or later. This is in addition to the submission of any paper copies required. The diskette shall be clearly labeled with the contract title, ARB contract number, the words "Final Report", and the date the report was submitted.

Legibility. Each page of the approved Final Report must be legible and camera-ready.

Binding. The draft Report, including its appendices, must be either spiral bound or stapled, depending on size. The revised Report and its appendices should be spiral bound, except for two unbound, camera-ready originals.

Cover. Do not supply a cover for the Report. The ARB will provide its standard cover.

One-sided vs. two-sided. To conserve paper, both the draft Report and the revised Report, except for the unbound camera-ready copies, should be printed on both sides of the page. The unbound camera-ready copies must be printed on only one side of the page.

Title. The title of the Report should exactly duplicate the title of the contract unless a change is approved in writing by the contract manager.

Spacing. In order to conserve paper, copying costs, and postage, please use single or one-line (1) spacing.

Page size. All pages should be of standard size (8 ½" x 11") to allow for photo-reproduction.

Large tables or figures. Foldout or photo-reduced tables or figures are not acceptable because they cannot be readily reproduced. Large tables and figures should be presented on consecutive
8 ½" x 11" pages, each page containing one portion of the larger chart.

Color. Color presentations are not acceptable; printing shall be black on white only.

Corporate identification. Do not include corporate identification on any page of the Final Report, except the title page.

Unit notation. Measurements in the Reports should be expressed in metric units. However, for the convenience of engineers and other scientists accustomed to using the British system, values may be given in British units as well in parentheses after the value in metric units. The expression of measurements in both systems is especially encouraged for engineering reports.

Section order. The Report should contain the following sections, in the order listed below:

Title page
Disclaimer
Acknowledgment (1)
Acknowledgment (2)
Table of Contents
List of Figures
List of Tables
Abstract
Executive Summary
Body of Report
References
List of inventions reported and copyrighted materials produced
Glossary of Terms, Abbreviations, and Symbols
Appendices

Page numbering. Beginning with the body of the Report, pages shall be numbered consecutively beginning with "1", including all appendices and attachments. Pages preceding the body of the Report shall be numbered consecutively, in ascending order, with small Roman numerals.

Title page. The title page should include, at a minimum, the contract number, contract title, name of the principal investigator, contractor organization, date, and this statement: "Prepared for the California Air Resources Board and the California Environmental Protection Agency"

Disclaimer. A page dedicated to this statement must follow the Title Page:

The statements and conclusions in this Report are those of the contractor and not necessarily those of the California Air Resources Board. The mention of commercial products, their source, or their use in connection with material reported herein is not to be construed as actual or implied endorsement of such products.

Acknowledgment (1). Only this section should contain acknowledgments of key personnel and organizations who were associated with the project. The last paragraph of the acknowledgments must read as follows:

This Report was submitted in fulfillment of [ARB contract number and project title] by [contractor organization] under the [partial] sponsorship of the California Air Resources Board. Work was completed as of [date].

Acknowledgment (2). Health reports should include an acknowledgment to the late Dr. Friedman. Reports should include the following paragraph:

This project is funded under the ARB's Dr. William F. Friedman Health Research Program. During Dr. Friedman's tenure on the Board, he played a major role in guiding ARB's health research program. His commitment to the citizens of California was evident through his personal and professional interest in the Board's health research, especially in studies related to children's health. The Board is sincerely grateful for all of Dr. Friedman's personal and professional contributions to the State of California.

Table of Contents. This should list all the sections, chapters, and appendices, together with their page numbers. Check for completeness and correct reference to pages in the Report.

List of Figures. This list is optional if there are fewer than five illustrations.

List of Tables. This list is optional if there are fewer than five tables.

Abstract. The abstract should tell the reader, in nontechnical terms, the purpose and scope of the work undertaken, describe the work performed, and present the results obtained and conclusions. The purpose of the abstract is to provide the reader with useful information and a means of determining whether the complete document should be obtained for study. The length of the abstract should be no more than about 200 words. Only those concepts that are addressed in the executive summary should be included in the abstract.

Example of an abstract:

A recently developed ground-based instrument, employing light detecting and ranging (lidar) technology, was evaluated and found to accurately measure ozone concentrations at altitudes of up to 3,000 meters. The novel approach used in this study provides true vertical distributions of ozone concentrations aloft and better temporal coverage of these distributions than other, more common methods, such as those using aircraft and ozonesonde (balloon) techniques. The ozone and aerosol measurements from this study, in conjunction with temperature and wind measurements, will provide a better characterization of atmospheric conditions aloft and the processes involved in the formation of unhealthful ozone concentrations than can be achieved with traditional ground-based monitors.

Executive Summary. The function of the executive summary is to inform the reader about the important aspects of the work that was done, permitting the reader to understand the research without reading the entire Report. It should state the objectives of the research and briefly describe the experimental methodology[ies] used, results, conclusions, and recommendations for further study. All of the concepts brought out in the abstract should be expanded upon in the Executive Summary. Conversely, the Executive Summary should not contain concepts that are not expanded upon in the body of the Report.

The Executive Summary will be used in several applications as written; therefore, please observe the style considerations discussed below.

Limit the Executive Summary to two pages, single spaced.

Use narrative form. Use a style and vocabulary level comparable to that in Scientific American or the New York Times.

Do not list contract tasks in lieu of discussing the methodology.

Discuss the results rather than listing them.

Avoid jargon.

Define technical terms.

Use passive voice if active voice is awkward.

Avoid the temptation to lump separate topics together in one sentence to cut down on length.

The Executive Summary should contain four sections: Background, Methods, Results, and Conclusions, described below.

THE BACKGROUND SECTION. For the Background, provide a one-paragraph discussion of the reasons the research was needed. Relate the research to the Board's regulatory functions, such as establishing ambient air quality standards for the protection of human health, crops, and ecosystems; the improvement and updating of emissions inventories; and the development of air pollution control strategies.

THE METHODS SECTION. At the beginning of the Methods section, state what was done in general, in one or two sentences.

The methodology should be described in general, nontechnical terms, unless the purpose of the research was to develop a new methodology or demonstrate a new apparatus or technique. Even in those cases, technical aspects of the methodology should be kept to the minimum necessary for understanding the project. Use

terminology with which the reader is likely to be familiar. If it is necessary to use technical terms, define them. Details, such as names of manufacturers and statistical analysis techniques, should be omitted.

Specify when and where the study was performed, if it is important in interpreting the results.

The findings should not be mentioned in the Methods section.

THE RESULTS SECTION. The Results section should be a single paragraph in which the main findings are cited and their significance briefly discussed. The results should be presented as a narrative, not a list. This section must include a discussion of the implications of the work for the Board's relevant regulatory programs.

THE CONCLUSIONS SECTION. The Conclusions section should be a single short paragraph in which the results are related to the background, objectives, and methods. Again, this should be presented as a narrative rather than a list. Include a short discussion of recommendations for further study, adhering to the guidelines for the Recommendations section in the body of the Report.

Body of Report. The body of the Report should contain the details of the research, divided into the following sections:

INTRODUCTION. Clearly identify the scope and purpose of the project. Provide a general background of the project. Explicitly state the assumptions of the study.

Clearly describe the hypothesis or problem the research was designed to address. Discuss previous related work and provide a brief review of the relevant literature on the topic.

MATERIALS AND METHODS. Describe the various phases of the project, the theoretical approach to the solution of the problem being addressed, and limitations to the work. Describe the design and construction phases of the project, materials, equipment, instrumentation, and methodology. Describe quality assurance and quality control procedures used. Describe the experimental or evaluation phase of the project

RESULTS. Present the results in an orderly and coherent sequence. Describe statistical procedures used and their assumptions. Discuss information presented in tables, figures and graphs. The titles and heading of tables, graphs, and figures, should be understandable without reference to the text. Include all necessary explanatory footnotes. Clearly indicate the measurement units used.

DISCUSSION. Interpret the data in the context of the original hypothesis or problem. Does the data support the hypothesis or provide solutions to the research problem? If appropriate, discuss how the results compare to data from similar or related studies. What are the implications of the findings? Identify innovations or development of new techniques or processes. If appropriate, discuss cost projections and economic analyses.

SUMMARY AND CONCLUSIONS. This is the most important part of the Report because it is the section that will probably be read most frequently. This section should begin with a clear, concise statement of what, why, and how the project was done. Major results and conclusions of the study should then be presented, using clear, concise statements. Make sure the conclusions reached are fully supported by the results of the study. Do not overstate or overinterpret the results. It may be useful to itemize primary results and conclusions. A simple table or graph may be used to illustrate.

RECOMMENDATIONS. Use clear, concise statements to recommend (if appropriate) future research that is a reasonable progression of the study and can be supported by the results and discussion.

References. Use a consistent style to fully cite work referenced throughout the Report and references to closely related work, background material, and publications that offer additional information on aspects of the work. Please list these together in a separate section, following the body of the Report. If the Report is lengthy, you may list the references at the end of each chapter.

List of inventions reported and publications produced. If any inventions have been reported, or publications or pending publications have been produced as a result of the project, the titles, authors, journals or magazines, and identifying numbers that will assist in locating such information should be included in this section.

Glossary of terms, abbreviations, and symbols. When more than five of these items are used in the text of the Report, prepare a complete listing with explanations and definitions. It is expected that every abbreviation and symbol will be written out at its first appearance in the Report, with the abbreviation or symbol following in parentheses [i.e., carbon dioxide (CO_2)]. Symbols listed in table and figure legends need not be listed in the Glossary.

Appendices. Related or additional material that is too bulky or detailed to include within the discussion portion of the Report shall be placed in appendices. If a Report has only one appendix, it should be entitled "APPENDIX". If a Report has more than one appendix, each should be designated with a capital letter (APPENDIX A, APPENDIX B). If the appendices are too large for inclusion in the Report, they should be collated, following the binding requirements for the Report, as a separate document. The contract manager will determine whether appendices are to be included in the Report or treated separately. Page numbers of appendices included in the Report should continue the page numbering of the Report body. Pages of separated appendices should be numbered consecutively, beginning at "1".