FINAL REPORT

The CoolCalifornia Challenge: A Pilot Inter-City Household Carbon Footprint Reduction Competition

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Table of Contents

List of Figures

List of Tables

Abstract

This study developed, implemented and evaluated a pilot greenhouse gas reduction competition between eight California cities. The program used techniques common to behavioral interventions, including commitments, goal setting, feedback, local messengers, social networks, persuasive messaging, incentives and competition to recruit and engage households in a yearlong program. Participants earned points for tracking and reducing household energy consumption and motor vehicle emissions, as well as for taking simple one-time actions, like inviting friends, uploading stories and completing a research survey. Participating cities enrolled 2,667 households and logged over 10,000 electricity, natural gas and motor vehicle odometer readings in the online software. Participants entering energy data used about 14% less electricity than a control group, but did not use less natural gas, possibly due to lack of competition deadlines during winter months when opportunities to reduce natural gas are higher, and fewer natural gas end uses for potential reductions. Older and more highly educated participants outperformed younger and less educated participants, while income, political identity and attitudes toward climate change affected participation levels, but not performance. Participants reported very altruistic motivations for joining the program, including improving where they live, protecting the environment and helping organizations they care about. While winning prizes and earning recognition for their city ranked low on a list of reported motivations, participation in the program dramatically spiked only during intense moments of competition. Together, this evidence suggests that inter-city competitions can be a successful strategy to reduce community-wide greenhouse gas emissions.

1. Executive Summary

Background
The State of California's target to reduce greenhouse gas emissions 80% by 2050 will require massive engagement of Californians to adopt low carbon technologies and practices. Recent advances in behavioral science and praxis have revealed that community-based programs are well suited to identify and overcome barriers to low-carbon lifestyles, and to accentuate the benefits. Among community-based interventions, competitions are becoming an increasingly popular strategy to engage hard to reach populations in energy efficiency and sustainability. Community-based competitions act as a catalyst to engage networks of individuals and organizations in a shared, community-wide goal.

Methods
The goals of this study were to design, implement and evaluate an energy and carbon footprint reduction competition among California households and communities. Eight cities successfully completed the application and enrolled in the pilot program, which ran from April 1, 2012 through May 30, 2013. Households earned points by tracking and lowering electricity and natural gas consumption and motor vehicle emissions, as well as for taking small actions, like inviting friends or sharing stories. Participants received regular messaging, feedback in an online software platform, prompts from community members, occasional raffle prizes and recognition. Participants were also asked to voluntarily fill out an online research survey with questions on attitudes, values, level of engagement with low carbon actions and demographic information. Total energy and greenhouse gas (GHG) savings were calculated by comparing self-reported energy usage with a control group of participants who enrolled later in the program. Six months following the end of the program, a post-program participant evaluation survey was administered and interviews with city program managers were conducted to uncover qualitative lessons from the intervention.

Results
The 13-month pilot program enrolled 2,667 households in eight participating cities. Over 900 participants manually entered more than 10,000 monthly electricity, natural gas and motor vehicle readings in the online software, far exceeding the level of participation anticipated at the outset of the program. Over one year, households entering energy data used an average of 14% less electricity than a control group of similar households joining the program at a later date; however, there were no discernible reductions in natural gas consumption, possibly due to the timing of the program, which did not include any deadlines during winter months, and fewer natural gas end uses for potential reductions. The primary reported motivations of participants were very similar across demographic and psychographic population segments, with altruistic motives far outranking financial savings or extrinsic motives. Somewhat surprisingly, older households far outperformed younger households, as did households with higher education, while income, political identity and attitudes toward climate change affected participation levels, but not performance, or points. At the end of the program cities that earned the most points were recognized at an awards ceremony by the California Air Resources Board in Sacramento. Despite challenges with software and several important changes to the program design, participants and city program managers generally had a positive view of the program and provided important feedback to improve future iterations.

Conclusion

There is high level of interest across California cities for successful community engagement programs. Participation levels in the pilot CoolCalifornia Challenge program far exceeded expectations with nearly 3,000 total participants and 14% electricity savings. While participants reported primarily altruistic motivations for participation, voluntary levels of participation dramatically spiked only during intense levels of competition. In order to realize the full promise of a statewide inter-city competition model, future programs should seek to increase motivation for all cities, even those not directly contending for top honors, and care should be taken to design programs to meet a wide range of needs from communities with different levels of capacity and diverse populations.

2. Introduction

2.1. Scope and Purpose

The goals of this project were to design, implement and evaluate a carbon footprint reduction program for California households and communities. The program, called the CoolCalifornia Challenge (or simply the "Challenge"), used inter-city competition and community-based social marketing strategies to motivate residents in participating California cities to understand, track and reduce household greenhouse gas emissions.

A number of recent studies (Long et al. 2011; Williams et al. 2012; Wei et al. 2013) have concluded that large scale adoption of energy efficient and low carbon technologies will be required for California to meet its 80% GHG reduction target (Executive Order S-3-05). These studies further show that even if low carbon technologies can be scaled up to near technical potential, additional savings will be required from conservation, or else entirely new technologies will need to be developed, likely at considerable cost. Unlike changes in technology and infrastructure, which require heavy investments and long lead times, behavior change programs can offer quick and potentially low-cost solutions (Dietz et al. 2009).

Efforts to encourage pro-environmental behaviors have been largely limited to small-scale projects that target actions for specific populations (McKenzie-Mohr n.d.). One approach, providing comparative feedback via home energy reports, has reached large scales; however, savings have been modest, typically between 1-2% (Ayres, Raseman, and Shih 2012; Allcott 2011). Low-cost, highly scalable intervention models that achieve deeper savings for large, diverse populations are needed to ramp up greenhouse gas reductions.

This study developed a pilot inter-city greenhouse gas reduction program between eight participating California cities. This project serves as a living laboratory to test new approaches to engage California residents and communities in climate action. This effort supports the goals of the California Global Warming Solutions Act (AB 32); as specified in the California Air Resources Board's AB 32 Scoping Plan, voluntary actions are an essential component of the state's GHG reduction portfolio.

2.2. Background

Previous studies have highlighted the effectiveness of competitions to motivate more sustainable behavior, particularly when combined with other intervention strategies, such as providing tailored information, encouraging commitments and goal setting, modeling of normative behavior, providing personal and comparative feedback and offering rewards like recognition and prizes (Petersen et al. 2007). Competition between groups fosters in-group collaboration, proving social motivations, and complementing intrinsic motivations for pro-social and pro-environmental behavior. Individuals' values, habits, abilities, attitudes, social ties and worldviews are also among the factors that influence behavior (Stern 2000). Competitions are thought to be particularly effective at engaging otherwise hard to reach populations (McKenzie-Mohr and Schultz 2014) and not just the lowest energy users, who themselves have diverse reasons for engagement in energy conservation (Reuben Deumling, Alan Meier, and Jonathan

Cook 2013). Energy and carbon footprint savings frequently result in average short-term savings 5-20% (Abrahamse 2005) and can lock in longer-term savings through purchase of new energy efficient equipment and habit formation (Maréchal 2010).

A common critique of competitions is that an overemphasis on tangible rewards can reduce intrinsic motivation for individuals to take the desired behaviors and decrease the likelihood that the behaviors will be sustained when the rewards are withdrawn at the end of the competition (Covington and Müeller 2001). This effect can be wholly or partially mitigated by minimizing tangible rewards and by offering positive feedback (Deci, Koestner, and Ryan 1999), which tends to increase intrinsic motivation. Additionally, competition alone, in the absence of external reward, is thought to increase intrinsic motivation, by making the activities more challenging and enjoyable. Evidence also suggests that recidivism after the competition ends depends on the type of reward and the social context in which rewards are offered; if intrinsic motivations are enhanced, the actions will be more likely sustained over time.

Thus, competitions may be helpful in encouraging participation in pro-social and pro-environmental behavior by making taking action more enjoyable, by providing feedback on performance, and by enhancing social interaction among participants. Since individuals did not receive prizes themselves in the Challenge intervention, the focus was on community benefits and recognition for city-wide achievements. Some cities did offer occasional raffle prizes based on points, but these were offered as surprise gifts and were not a central focus of the program. Messaging also focused on intrinsic motivations and utilized a number of behavior strategies, including comparative feedback, normative messaging, peers modeling desired behaviors and other strategies. The combination of these strategies was designed to enhance intrinsic motivation, while competition is used to make participation more meaningful and enjoyable for participants.

Inter-city energy and greenhouse gas reduction competitions have only recently been tried (e.g., Mass Saves Challenge, the Kansas Energy Challenge). Previous programs have not been rigorously evaluated and little is known about why programs may or may not be successful. This study provides one of the first opportunities to evaluate a statewide inter-city greenhouse gas reduction competition. Given the novelty of this program, this study serves as a case study to improve understanding of similar efforts.

2.3. Research Objectives

The primary goals of this study were to: 1) design and implement a pilot inter-city greenhouse gas reduction competitions between California cities, 2) administer a research survey to collect participant demographic information, attitudes, motivations, adoption of low carbon behaviors and other information, and 3) track and evaluate results.

The study tracked self-reported monthly natural gas and electricity consumption by ~900 total participants who recorded their monthly usage an average of five months per household. We use a quasi-experimental design to compare participants' monthly energy usage with participants who joined the program at a later date and estimated total program-wide savings of electricity, natural gas and greenhouse gas emissions.

Participants were asked to complete a research survey, including questions on their values, attitudes, motivations, commitment to sustainable lifestyles, and demographic characteristics. In order to understand the effectiveness of the program to engage different population segments we compared points earned by households to responses from the research survey. As described in detail below, participants earned points earned for: 1) having lower energy consumption and motor vehicle usage than similar California households, 2) lowering energy usage and motor vehicle usage over time, and 3) taking simple, one-time actions.

3. Methods and Materials

3.1. Program Overview

Any California city interested in the program was encouraged to apply and participate. Applications were accepted from February 1, 2012 through February 29, 2012. Interested cities were required to submit a letter of support from a city manager or equivalent stating the city's commitment to participate in the program. The first six cities that submitted letters of support signed by city managers received $1,000 in seed money. The city had the option of designating a community-based organization (CBO) to administer the program. If a CBO was in charge of administering the program locally, a letter of support from this organization was also required.

The California Air Resources Board, U.C. Berkeley and CoolCalifornia.org partner, Next Ten, announced the program and advertised on institutional email lists and a list of city sustainability officers throughout the state. Ten cities completed the application process by the required date; however, two cities, Gonzales and Santa Cruz, dropped out prior to the start of the competition due to staffing constraints, leaving eight cities in the pilot competition:

- Chula Vista
- Citrus Heights
- Davis
- Pittsburg
- Pleasanton
- San Jose
- Sacramento
- Tracy

Theses cities reflected a demographically diverse population with a range of population sizes as well as different levels of capacity and experience with community climate action. All cities had recently completed climate action plans that called for some level of engagement with residents. In many cases the Challenge was the city's first engagement with residents on this issue.

The CoolCalifornia Challenge ("the Challenge") management team at U.C. Berkeley worked directly with city program managers in each city, providing supporting resources, including: 1) marketing information (brochures, videos, market segmentation research, graphically-enhanced email communication, etc.), 2) survey results (in aggregated form), 3) a calendar of monthly themes and suggested activities, 4) community-based social marketing workshops (online during the Qualifying Round and in-person and online during Finalists Round), and day-to-day support. Other resources were contributed by cities depending on their needs and capabilities, including staff and volunteer time, print materials, coordination of local events, communication with participants via the Challenge software and local program management.

3.1.1. Target Population

Based on a California-focused population segmentation study (Opinion Dynamics 2009) the research team anticipated that two generalized groups would be primarily interested in the Challenge. The first group, called "leading achievers," would be largely well-educated, politically liberal homeowners who are already very knowledgeable and committed to energy efficiency and climate change, and who would be good candidates for large investments and deep conservation practices. The second group, called "striving believers," is younger, more urban and also politically liberal, but due to competing interests, lower incomes and renter status, has not made significant investments in energy efficient technologies. This group is more influenced by peers, highly connected to social media, and more motivated by fun interventions that improve social interactions. Together, these two groups represent nearly 50% of California's population. A third group, called "practical spenders," is older, more conservative and also quite savvy about energy efficiency, but would be less motivated by environmental appeals and not as likely to join the program.

Cities were also encouraged to foster engagement of more specific population segments via the creation of "EcoTeams," or self-organizing groups of participants. EcoTeams could be formed by schools, churches, city offices, community-based organizations or other groups interested in competing against similar teams. EcoTeams would know the best way to communicate with and motivate their more specific populations.

3.1.2. Timeline

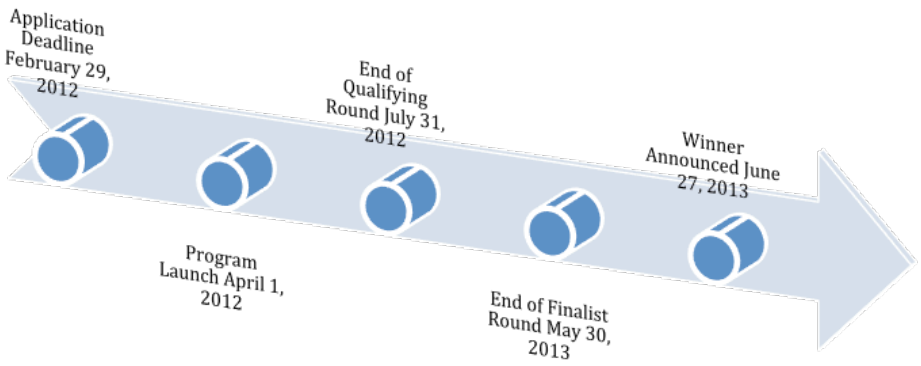

Figure 1. Timeline of the CoolCalifornia Challenge Pilot Competition

The Challenge started on April 1, 2012 and ran through May 30, 2013. The month of April 2012 was called the "**warm up month**," which was designed to give cities the opportunity to become familiar with the software and to start formulating their plans for participation in the Challenge. During this period participants were able to sign up and start earning points in the CoolCalifornia Challenge.

The "**Qualifying Round**," which ran from May 1 through July 31, 2012, was designed to encourage broad participation of California communities in the program and to select the most dedicated cites to compete to become the "Coolest California City." At the end of each month of the Qualifying Round the city with the most points was deemed a "Finalist" and awarded $10,000 in "seed money."

The CoolCalifornia Challenge provided in-kind and financial support to cities participating in the program. The first six cities to apply received $1,000 in seed money. Each winner of the 3-month Qualifying Round was also to receive $10,000. Seven cities in the Pacific Gas & Electric Company (PG&E) territory received additional seed money of $2,500 each from PG&E. The City of Chula Vista was supported separately via contracts with their local utility, San Diego Gas & Electric Company.

The City of Davis became the first finalist at the end of May, followed by the City of Sacramento at the end of June. The remaining cities competed for the last finalist spot during the month of July. The competition between the cities of Tracy and Chula Vista was extremely intense during the final days of the month, with each city trading places on the leaderboard multiple times. By midnight of July 31, both teams had earned almost the same number of points, within less than 0.5%. Both cities agreed to declare a tie and share the prize money ($5,000 each). The cities of Davis and Sacramento also agreed to have an additional city as a finalist, although there was some concern that four cities would spread staff resources and coordination more thinly.

The "**Finalists Round**" ran from August 1, 2012 through April 30, 2013; however, cities were given until May 30 to enter energy bills and vehicle odometer readings for the month of April, resulting in a program ending date of May 30, 2013. The total program duration was 13 months, including the warm up month of April 2012, plus additional month of May 2013 to finish entering data. The program collected more than one year of data since participants were able to enter utility data and vehicle odometer readings dating back to March 1, 2012. The Finalists Round was designed to function similarly to the original competition design, which had three cities collaborating to implement a nine-month program (see Appendix H for a summary of program design changes from the original research contract).

At the end of the one-year pilot, the City of Davis had earned the most points and was officially declared the "Coolest California City" at an awards ceremony at a California Air Resources Board meeting in Sacramento. The city of Chula Vista came in a close second place and the city of Tracy was third place. Chula Vista and Tracy were each awarded recognition as a "Cool California City."

3.1.3. Software and Points Structure

U.C. Berkeley developed a sophisticated online software platform (see Appendix E for screenshot) allowing participants to create accounts, log electricity and natural gas bills, add motor vehicles and track odometer readings, join and manage teams, invite friends, share stories, take pledges, track progress and earn points for themselves, their teams and their cities. The software also included administrative accounts for city program managers allowing them to send formatted messages to their participants, administer raffles, and manage Ecoteams.

Developing the software proved to be much more time consuming, costly and complicated than originally envisioned in the research contract, which did not include funding for software development. Rather than try to extensively modify and repurpose an existing software tool developed for the purpose of calculating household carbon footprints (CoolCalifornia.org/calculator), U.C. Berkeley hired a small team of highly skilled computer programming students to build a new website from scratch and hired a fulltime staff person to design and manage the software development. The software launched on April 2, 2012 (a day after the intended start date due to a software bug) with basic functionality allowing users to create accounts, track energy data, earn points and monitor their city's progress on a scoreboard. New features were rolled out over the course of the yearlong program, as the user interface improved and bugs were tracked and resolved on an ongoing basis.

Participants earned points for the following:

1. KUDO POINTS for signing up & taking simple actions: Participants received 100 points for signing up and additional points for simple actions like filling out an online survey (100 points), uploading a photo (50 points), and inviting friends (20 points for every person who signs up).

2. GREEN POINTS for having carbon footprints from home energy and motor vehicles that are lower than similar households: Participants earned one point per pound of CO_2 lower than a benchmark value for similar households. Similar households were defined as having the same

number of people of the same ages living in the same city. Benchmark electricity, natural gas and vehicle miles were calculated for each city and for each household type by number of household members in each age group.

The benchmarking methodology for "similar households" is described in detail in (C. Jones and Kammen 2014), and summarized here. We use existing national household survey data to develop econometric models of demand for household electricity, natural gas, fuel oil and vehicle miles traveled. Independent variables used to predict household electricity, natural gas and other household heating fuels in the Residential Energy Consumption Survey (n = 4,363 households) include energy prices, heating fuel type, heating and cooling degree days, structure of homes (number of rooms, percent single-detached, year home built), demographic information (income, number of household members, age of householder, race), home ownership, percentage rural or urban, Census divisions, and U.S. state. Predictive variables for motor vehicles miles traveled (VMT) in the National Household Travel Survey (n = 11,744 households) include number of vehicles owned, fuel prices, average time to work, percentage of commuters who drive to work, demographic information (income, number of household members, race), number of food and recreation establishments in the zip code, population density, Census region, and U.S. state.

Figures 2, 3 and 4 show the benchmark monthly electricity, natural gas and vehicle miles traveled estimates for each of the Challenge cities. Monthly electricity and natural gas estimates were developed using local 30-year average heating and cooling degree days ("NCDC: Heating and Cooling Degree Day Data, (State, Regional, and National)" n.d.). The model somewhat overestimates electricity consumption for California households (likely due to California's stronger energy codes that are not well predicted by the model); however, this only serves to give all Challenge participants more points than they would with a lower benchmark and does not affect the results of this study.

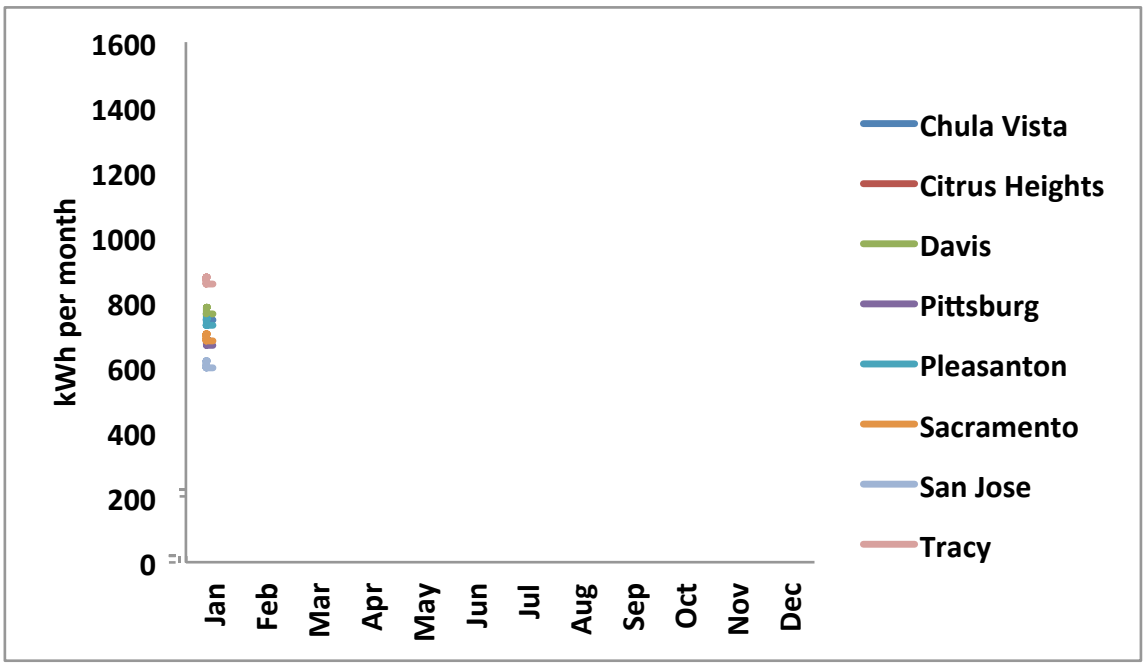

Figure 2. Benchmark kWh Electricity per Household by City

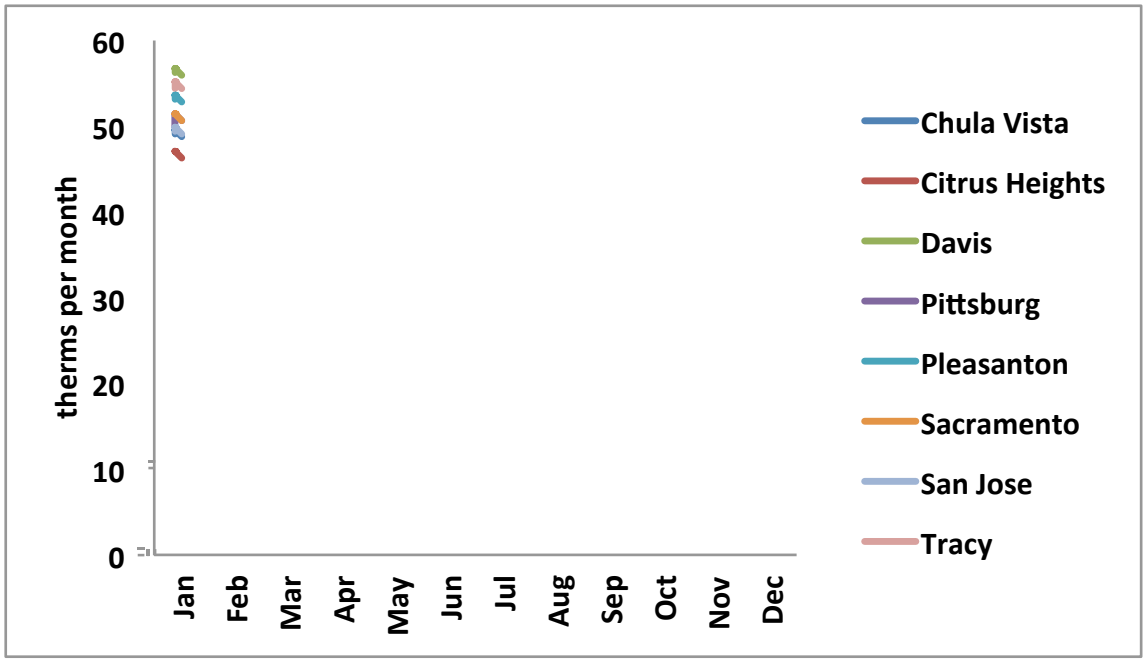

Figure 3. Benchmark Therms Natural Gas per Household by City

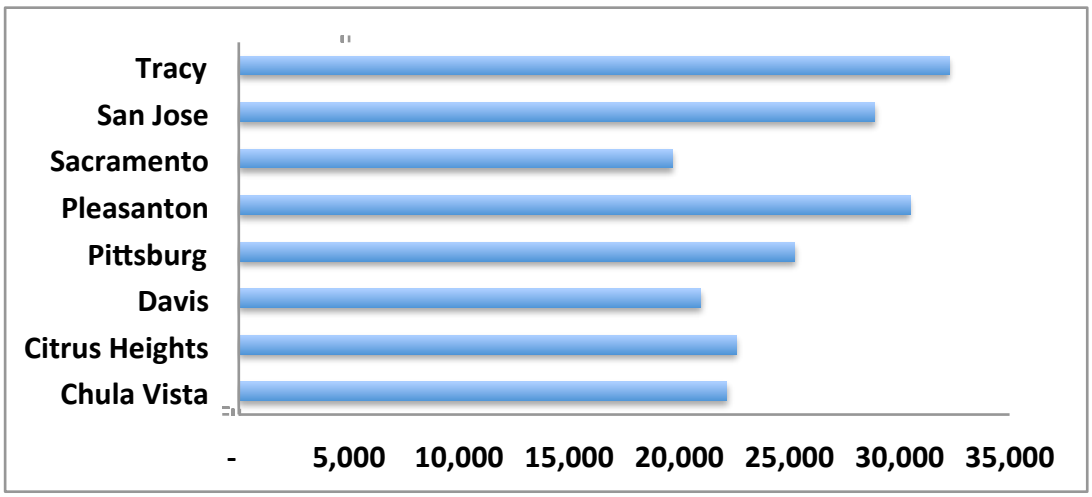

Figure 4. Benchmark Household Vehicle Miles Traveled by City

3. BONUS POINTS for beating past performance: Participants received bonus points for reducing energy and transportation carbon footprints compared to their household's performance in previous months. For example, if a household was 20% below similar households in March and 10% below similar households in April, the software calculates an expected personal benchmark of 15% below for May (the average of previous months). For every pound of CO_2 the household reduced below this personal benchmark they received bonus points equivalent to three times the value of CO_2 saved. These bonus points gave participants additional incentive to lower emissions beyond their reductions in previous months.

3.1.4. EcoTeams

During the original program design it was envisioned that most active participants would be organized into teams of 5-7 participants, called EcoTeams. Each EcoTeam would be responsible for enforcing the rules and expectations of the program and verifying the activities of its members. Participants who were not part of EcoTeams would have fewer opportunities to earn points, as agreed upon by a vote of city program managers in participating cities.

Unfortunately, creating the team features in the software proved more difficult than originally anticipated and this feature was not launched until February 2013. Teams did not have additional opportunities to earn points, as originally envisioned; however, there were some added benefits to joining teams, including team pages, team rankings, intra-city competitions between teams with natural rivalries (like city departments) and special recognition for the teams with the most points as of April 22, 2013, Earth Day.

3.1.5. Strategies and Activities Employed

The Challenge employed a number of strategies common to community-based social marketing (McKenzie-Mohr n.d.) and behavior-based energy reduction programs (Abrahamse et al. 2005), including:

- Feedback – letting participants know how well they are doing. See (M. A. Delmas, Fischlein, and Asensio 2013) for a recent review of feedback studies. Participants received comparative feedback, showing their rank in the program as an individual and as a team. They also received points based on their usage compared to similar households. Participants could also receive personalized feedback, with recommendations to reduce their carbon footprints by using the CoolCalifornia.org carbon footprint calculator and receive Kudo Points for uploading a screenshot of their results.

- Norms –information on how others like them behave (descriptive norms) and what behaviors are expected by peers (subjective norms) (Goldstein, Martin, and Cialdini 2008). Participants regularly received communication from local program managers encouraging them to join with others in their community (a descriptive norm) and why they should participate (a subjective norm). Program newsletters also frequently highlighted California-specific descriptive norms, e.g., statistics on the percentage of Californians who recycle, compost and support energy efficiency, and how many points were earned by participants in their community.

- Social Diffusion. Social diffusion happens when individuals share their experiences through social connections (McKenzie-Mohr n.d.). The CoolCalifornia Challenge tapped directly into established social networks in communities and indirectly through word of mouth, the media, email and other communications channels.

- Local leadership and capacity building. The success of the program depended largely on the ability of cities to organize a network of community leaders empowered to carry out the program. Local messengers understood local values and attitudes and were in a much better position to recruit, organize and motivate people they know than the organizers operating at the city level (Gershon 2009).

- Commitments and Goal Setting –Participants were encouraged to sign up and commit to regularly tracking energy and vehicle usage. Several goals were incorporated into the program, including becoming a "Cool California City" by entering the finalists round and becoming the "Coolest California City" for winning the competition. Participants were not given individualized goals for energy reduction, although this has also been shown to be an effective strategy (Abrahamse et al. 2005), but they were given a total collective goal of reducing 500,000 pounds of CO_2.

- Incentives. The CoolCalifornia Challenge provided recognition for participants' collective efforts as a city through their ranking in the program, and through participation in teams. Cities also had the option of using the software to select and contact raffle prizewinners, with each point counting as a raffle ticket. Raffle prizes included energy efficient products and gift cards to local stores or restaurants. One city, Chula Vista, also used seed funding for LED holiday lights and distributed them to Challenge participants in exchange for conventional holiday lights.

- Persuasive messaging. There are many strategies of effective communication (Goldstein, Martin, and Cialdini 2008). The CoolCalifornia Challenge team provided workshops, resources and one-on-one support to city program managers and community leaders on persuasive messaging, including the use of vivid imagery, stories, peer-to-peer learning, population segmentation, normative messaging and other techniques.

In addition to implementing these strategies in the software and email communications, U.C. Berkeley researchers provided workshops on community-based social marketing to finalist cities (Davis, Sacramento, Chula Vista and Tracy) and worked with these cities to develop appropriate implementation strategies during the Finalists Round. During these workshops finalist cities learned basic CBSM concepts, including 1) identifying the most promising behavior to target, 2) analysis of barriers and benefits of taking those actions, 3) developing intervention strategies, 4) piloting, and 5) scaling up interventions. Each city was encouraged to develop its own unique interventions, targeting specific actions for different populations within each city. While cities were not able to fully implement all CBSM steps, they did develop their own unique interventions. For example, the city of Sacramento developed the "Cut Your Cubes" campaign including a downtown sustainable practices scavenger hunt exclusively for Challenge participants, the city of Chula Vista conducted a holiday lighting exchange and the city of Davis began a 3-year household carbon footprint reduction campaign based on CBSM principles.

3.3. Research Surveys

All participants were asked to voluntarily complete a research survey during and after the competition. The survey contained three sections: demographics, lifestyle, and opinions & attitudes. A fourth section on EcoTeams was also asked, but sufficient data were not collected so this is not evaluated in this report. A full list of questions is available as Appendix B in this report. As a small reward and incentive, participants earned 100 points for completing the survey. Three hundred thirty-four participants successfully completed the online survey. Six months following the end of the program participants were asked to log into the Challenge software and take a second survey that included additional questions evaluating their experience in the program (Appendix C). Sixty-three participants completed the second survey.

3.4. Experimental Design

The vast majority of behavior change programs are opt-in and therefore do not have the benefit of a true control group since those who opt-in may be different in fundamental ways than those who have not opted in. In these cases, the best option is to delay the treatment to a randomly selected portion of participants for use as a control group. In the absence of a waitlist or delayed control, a Variability in Adoption (VIA) design is considered the next best option for quasi-experiments (Opinion Dynamics/Navigant 2012; DNV-GL 2014). In VIA models, participants who opt-in to a program later are compared to participants who opt-in earlier. For example, the energy use of the control group prior to joining the program may be compared to energy use of program participants during the same time period. The two groups should be carefully assessed for similarities since the control group serves as a presumed counterfactual of the treatment group had they not joined the program.

We used a VIA model to evaluate electricity and natural gas usage. Participants were able to earn points for reporting energy usage dating back to the beginning of the program, even if they had joined late in the program. This aided in the data collection for the project as well as allowed participants to enter multiple bills at one time. Figure 6 shows the monthly number of electricity and natural gas reports that were available as a treatment group and as a control group using this method. Since participants were able to join at any point during the 13-month program, the number of households in the treatment group and control group changed on a rolling basis. The treatment group submitting reports in any given month typically ranged between 150 and 250 households. The size of the control group ranged between 55 and 275 participants prior to October 2012, but dropped to under 30 households thereafter, making comparison between the two groups at the end of the program far less accurate.

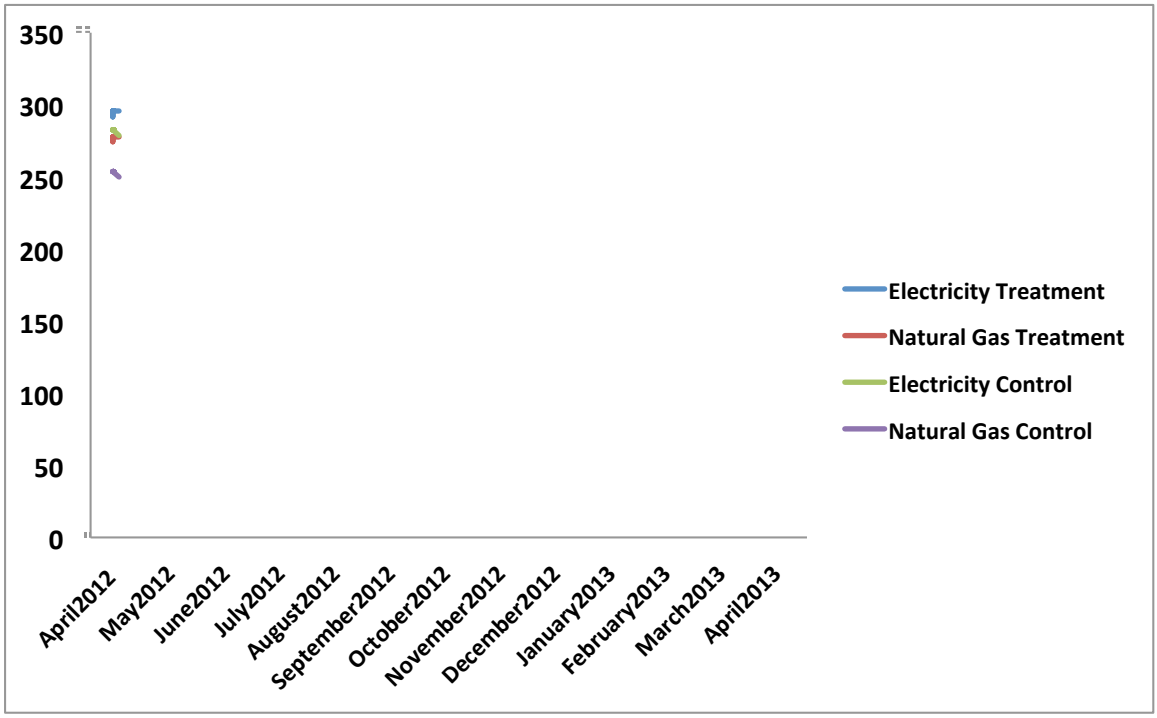

Figure 5. Size of Treatment and Control Groups

Assessment of Similarities Between Control and Treatment Groups

In order to evaluate similarities and differences between the treatment and control groups we combined survey data, which included questions on demographics and attitudes, with self-reported monthly energy data for the two groups. Of the 650 households completing at least two monthly energy data reports, 225 also filled out the research survey, providing reasonable confidence (+/- 5% margin of error at 95% confidence) that the household survey results represent the larger group of households providing energy data. However, it is important to keep in mind that the size of the control group is very small (under 30) after October 2012 and number of households who also completed the research survey for those months is smaller still. The discussion below therefore only refers to data from March 2012 through October 2012.

As shown in Figure 6, household size, age, gender and income were very similar between the treatment and control groups throughout the reporting period. Of all of these characteristics, differences in average household size would be particularly problematic; fortunately, there is a very high degree of correlation between the two groups.

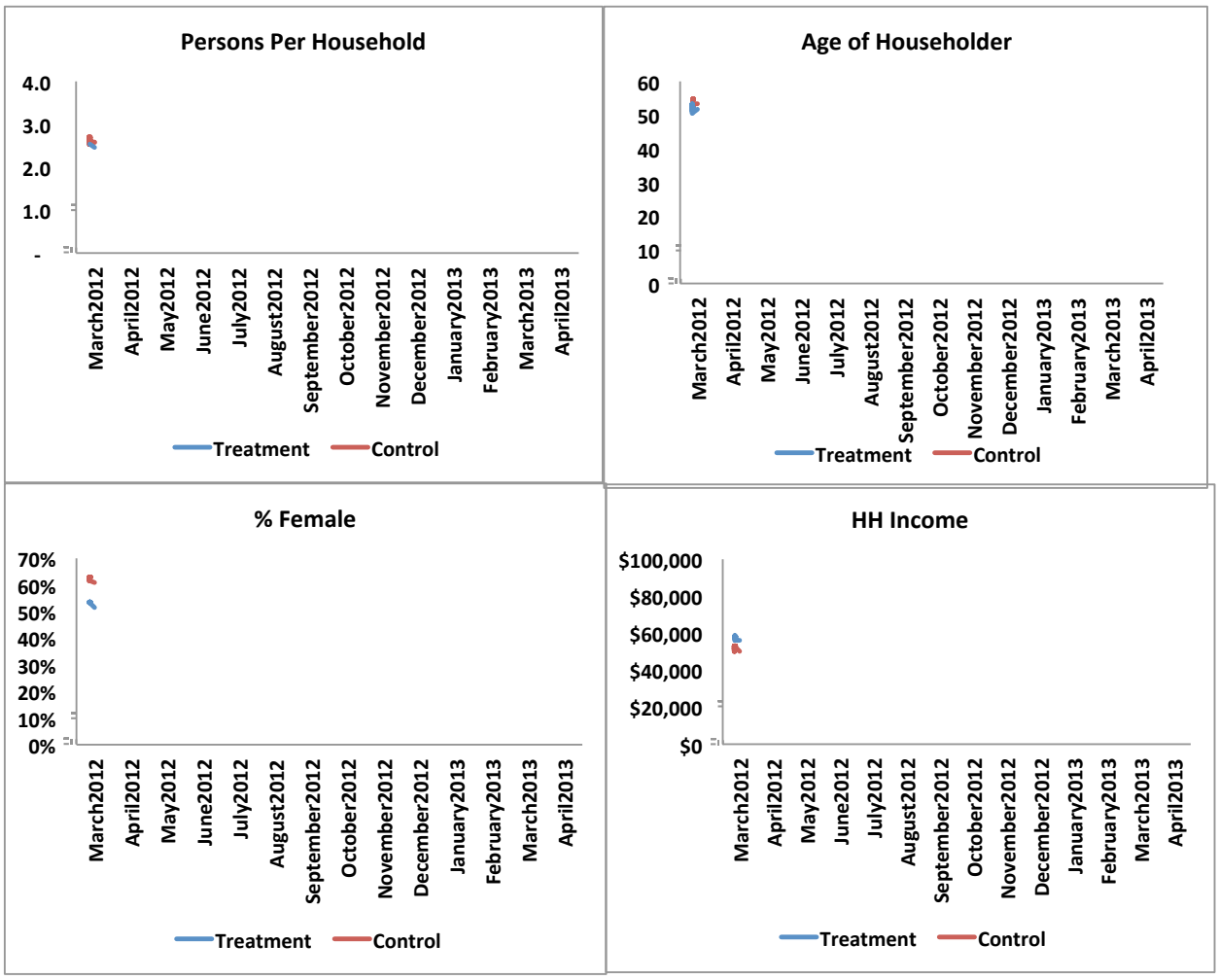

Figure 6. Household Size, Age, Sex and Income of Treatment and Control Groups

Political party affiliation and level of education varied somewhat between the control and treatment groups (Figure 7). These characteristics have been shown to be strongly correlated with views on climate change (Maibach, Roser-Renouf, and Leiserowitz 2009), with more conservative and less educated households being less likely to believe in or be concerned about anthropogenic climate change. The treatment group is somewhat more conservative and less educated and may therefore be less motivated to reduce greenhouse gas emissions than households the treatment group, potentially weakening the experimental design. An alternative explanation, however, is that fraction of households living in more or less educated and politically liberal cities, in either the treatment or control group, changes over time. Thus, controlling for city could reduce the differences.

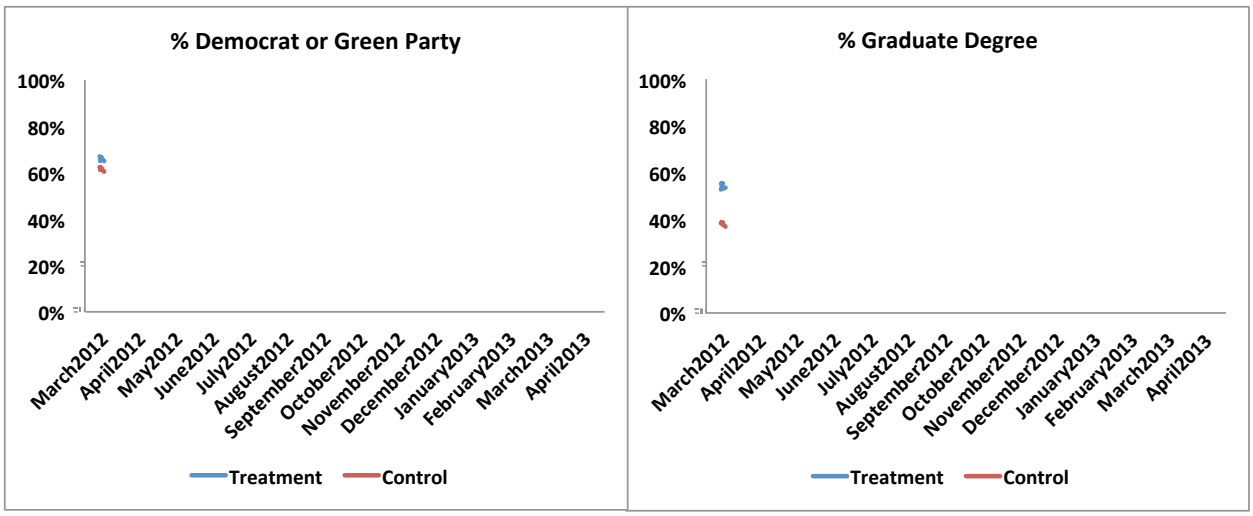

Figure 7. Political Party Affiliation and Graduate Degree Attainment of Treatment and Control Groups

As shown in Figure 8, the fraction of Davis households in the control and treatment groups varies to a similar degree as the variables shown in Figure 7. Davis participants are also much more likely to have a graduate degree than other cities (53% compared to 25%, on average) and are also more politically liberal. This lends evidence that the differences between the control and treatment group may be at least partially due to the composition of cities in each group over time.

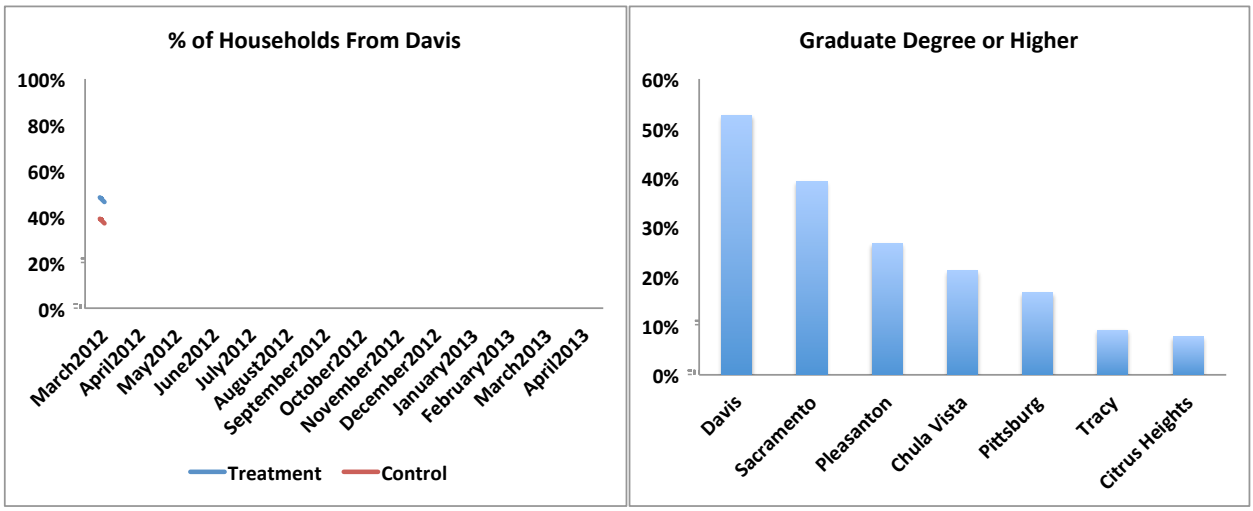

Figure 8. Graduate Degree by City and Fraction of Households from Davis

Figure 9 shows the number of households reporting electricity in each city for every month of the competition for both the treatment and control groups. During the first few months the number of reporting households in the treatment group grew to saturation level in about August, after which monthly reporting remained fairly constant at about 500 households per month. The fraction of households from each city in the treatment group stays fairly constant throughout the program period, but the fraction of households from each city varies considerably for the control group. This is shown best in Figure 10, which shows the same data as in Figure 10 but by percentage. Cities not only have different compositions of political affiliation and educational degree

attainment, but differences in weather, energy policies, culture and other characteristics, so controlling for city is critical to the experimental design.

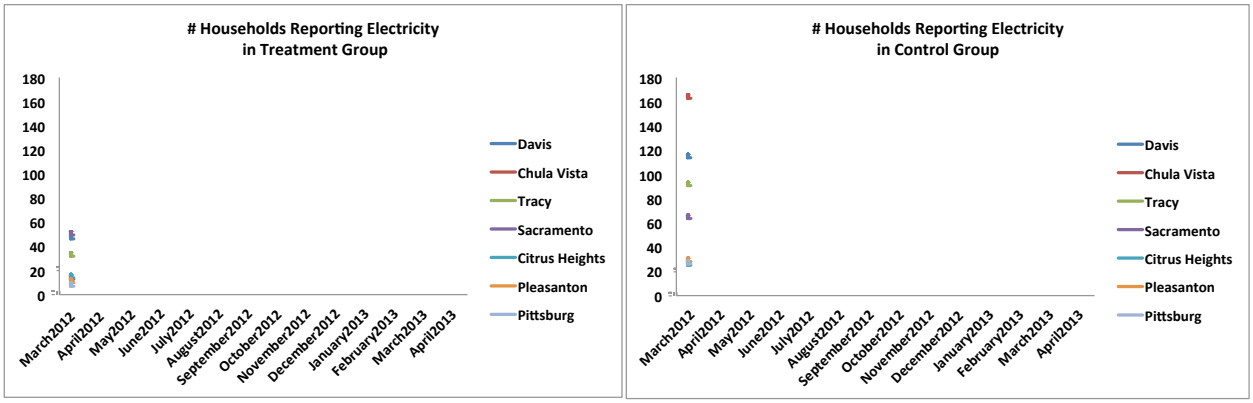

Figure 9. Number of Households Reporting Electricity in Treatment Group by City

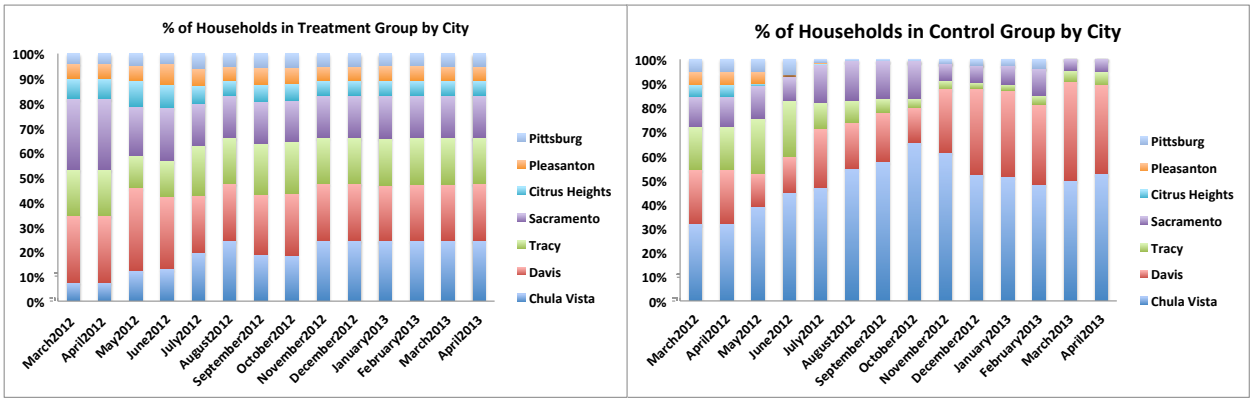

Figure 10. Fraction of Households in Treatment and Control Groups by City

Due to the very small sample size of households completing both the research survey and energy reports in each city it was not possible to examine the composition of control and treatment groups for each city; however, as expected, simply removing Davis households from the analysis does considerably reduce differences between the two groups. See Figure 11, which compares educational degree attainment with and without Davis households. Households in the treatment group for the remaining cities were somewhat more likely to have higher education than the control group; however, controlling for all cities may further minimize these differences, as well as differences in political party affiliation.

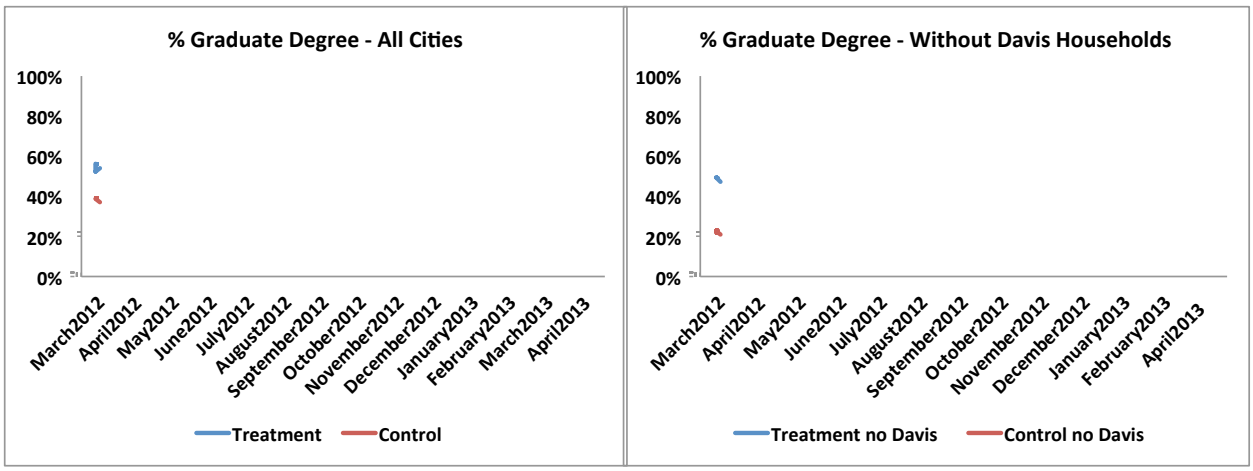

Figure 11. Graduate Degree Attainment with and without Davis

To account for differences between cities, we adjust each monthly household energy report as follows:

$EU_{kt} = REU_{kt} / (AEU_{ct} / AEU_{t})$

Where,

EU_{kt} is the energy use (electricity or natural gas) for household k in month t
REU_{kt} is the reported energy use for household k in month t
AEU_{ct} is the average energy use of all participants reporting in city c in month t
AEU_{t} is the average energy use of all program participants in month t

This approach normalizes average monthly energy use in each city to the average monthly energy use in all cities, for both the control and treatment groups, thus accounting for differences in weather, energy policies, housing stock, household characteristics and other factors that affect energy usage between cities.

Given the similarities in most demographic variables, and the additional control for location, we assume the control group acts as a counterfactual for the treatment group had they not joined the program. Nonetheless, it does make sense that the most motivated participants would join earlier, and less motivated participants would join later. This is a fundamental limitation with the VIA model that is not entirely possible to control for in this study. Given the small sample size of households completing survey responses and reporting energy in each city, multivariate regression techniques (see Opinion Dynamics, 2009; and DNV-GL 2014) were not possible to further align the control and treatment groups beyond the normalization by city.

We have limited our impact evaluation to electricity and natural gas. While several hundred participants also regularly recorded odometer readings of their vehicles, the majority of households only tracked one vehicle, particularly during the first months of the program. Since most households have more than one vehicle, we assumed this was a reporting error (and also a

problem with the feedback initially provided by the software to reduce this error) so we were not able to accurately evaluate reductions in household motor vehicle usage. It should be noted though that greenhouse gas emissions from motor vehicles are about three times larger than household energy GHG emissions in California (C. M. Jones and Kammen 2011) so total GHG reductions due to the program are likely considerably higher than those reported here.

3.5. Supplementary Interviews

Several months after the end of the program, city program managers were asked to be interviewed about their city's experience participating in the program. The interview included questions on their city's motivations for joining the program, the resources they had at their disposal to run the program, their evaluation of each of the main program activities, their opinion on the outcome and results, and their recommendation for future programs (Appendix E). Six city program managers completed the interviews.

4. Results

4.1. Participation

Figure 12 shows level of participation throughout the 13-month program as measured by number of new participants and number of monthly electricity reports. The vast majority of new enrollments (67%) joined during the Qualifying round, April 1 through July 31. Participation in the program, as measured here by the number of times households reported electricity, first peaked in May, when the first finalist city, Davis, was announced. Sacramento was then able to secure the second spot at the end of June without considerable competition and with somewhat lower overall level of participation. Chula Vista and Tracy engaged in a very intense competition for the last spot at the end of July. As was noted earlier, these two cities were almost exactly tied at the end of July and were both declared finalists in the program. There was another boost in enrollment in the first few months of the Finalists Round (fall 2012), but starting in January 2013 new sign ups were minimal. Participation was lowest in winter months when there were no program deadlines. The largest peak in participation was the last month of the program, when 33% of electricity reports were recorded. Based on this evidence it is clear that the timing of the program deadlines played a critical role in participation levels throughout the program.

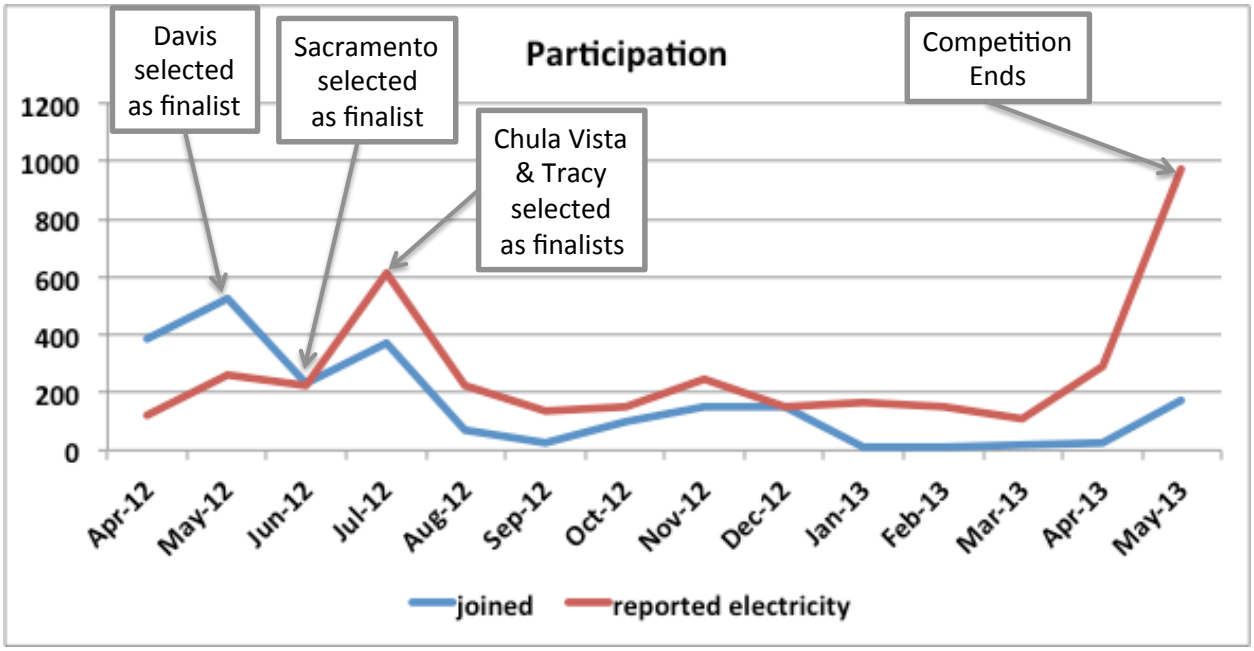

Figure 12. Participation Levels

4.2. Energy and GHG Reductions

Electricity

From April through October 2012, when the control group contained a sufficient number of subjects for a reasonable control, Challenge participants used 14% less electricity than the control group (Figure 13). During the entire 13-month program the treatment group used 19%

less electricity than the control group; however, due to the limited sample size of the control group after October we consider the lower estimate of 14% to be a more realistic estimate of total annual program savings. Savings were greatest during peak periods in summer and winter. Curiously, electricity demand was slightly higher in December and January than in August, the hottest summer month, for both the treatment and control groups. It is unclear why this occurred, but it may be due to additional electric space and water heating during the coldest months and more days spent at home during holidays. Electricity consumption was very similar between the two groups in March 2012, one month prior to the start of the program, and through the first three months when households were signing up for the program.

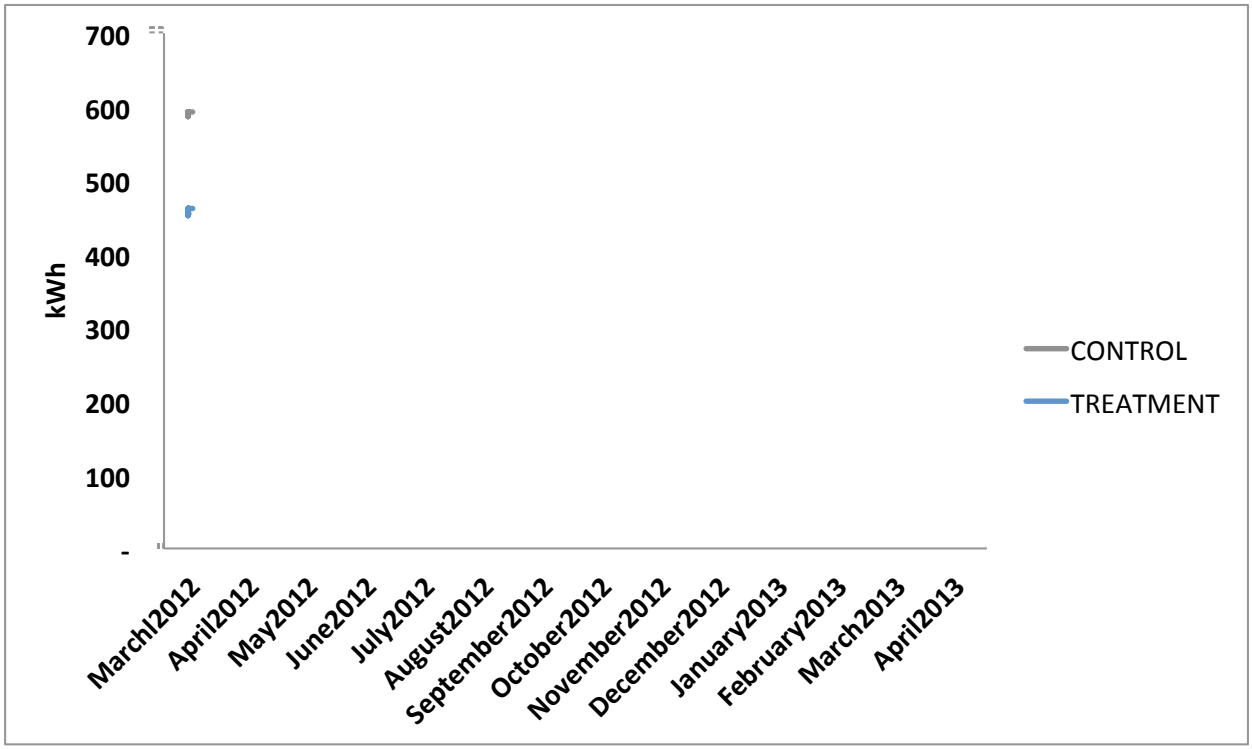

Figure 13. Electricity Consumption of Treatment Group vs. Control Group

Electricity consumption varied considerably by city and also, of course, between households within cities (see Figure 14 and Appendix A for summary statistics). Since the program was opt-in, most participants did not enter data for the first few months of the program so the sample size of each city is quite small until about July or August when each city consistently had over 100 entries per month (Figure 10). It is therefore not possible to evaluate the overall trend for each city. Even if this were possible it is important to note that increasing consumption would not be an indication of lack of a program effect since consumption increased considerably more for the control group than for program participants and the data presented below are not normalized by weather.

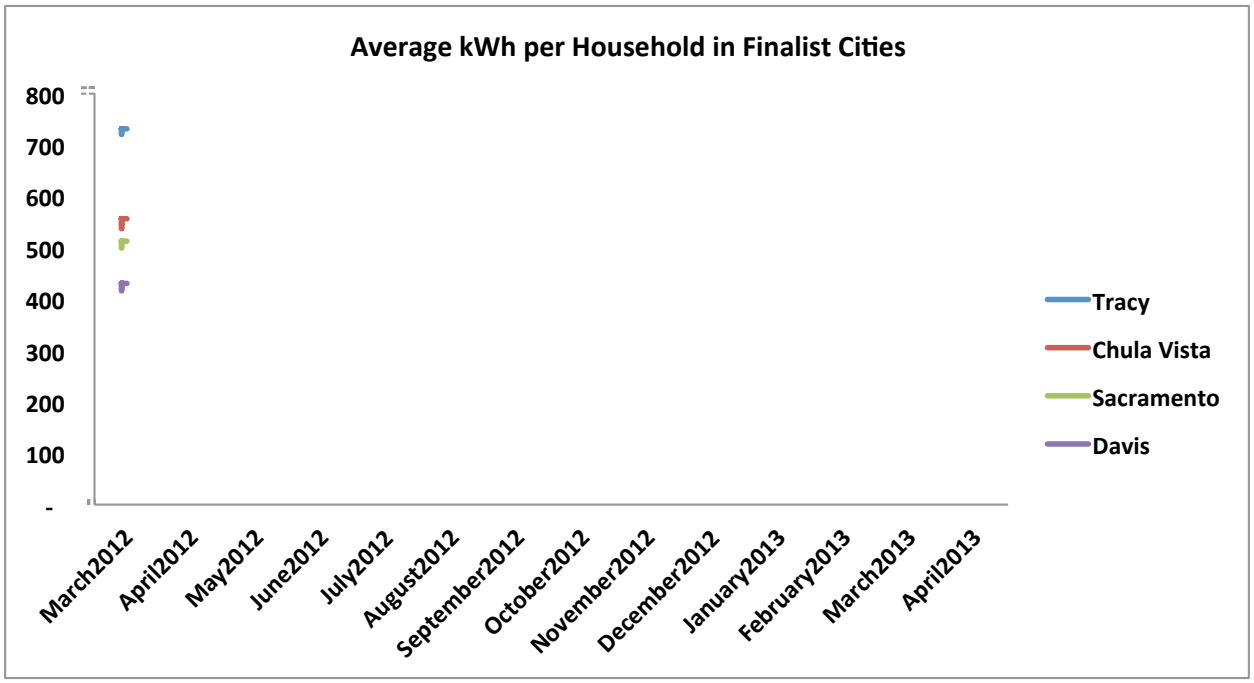

Figure 14. Average Monthly Electricity Consumption by City

Natural Gas

In contrast to electricity, participants demonstrated essentially no savings in natural gas consumption (Figure 15). Between April and October, when the size of the control group was between 55 and 275 households, both the treatment and control groups used exactly 97.8 therms and monthly usage was quite similar with no clear pattern. After October the size of the treatment group falls to below 30 households, so we are not able to evaluate usage with any statistical confidence. For comparison purposes we have included the California benchmark value, as computed by the software (Jones and Kammen, 2014) and adjusted for average California consumption of 6,992 kWh/yr (U.S. Energy Information Administration 2005). Natural gas consumption in summer months was about 50% below that of average California households with similar location, size and age of householder, but 20% higher during the winter heating period. The benchmark is a modeled result and not a statewide average, but it does help confirm that natural gas was likely not reduced in winter months (see the Discussion and Conclusion sections for potential reasons why there were no savings of natural gas). While there are no measurable savings in natural gas, the close alignment between the control group and the treatment group through October 2012 suggests that the experimental design is sound and calculated savings in electricity are realistic.

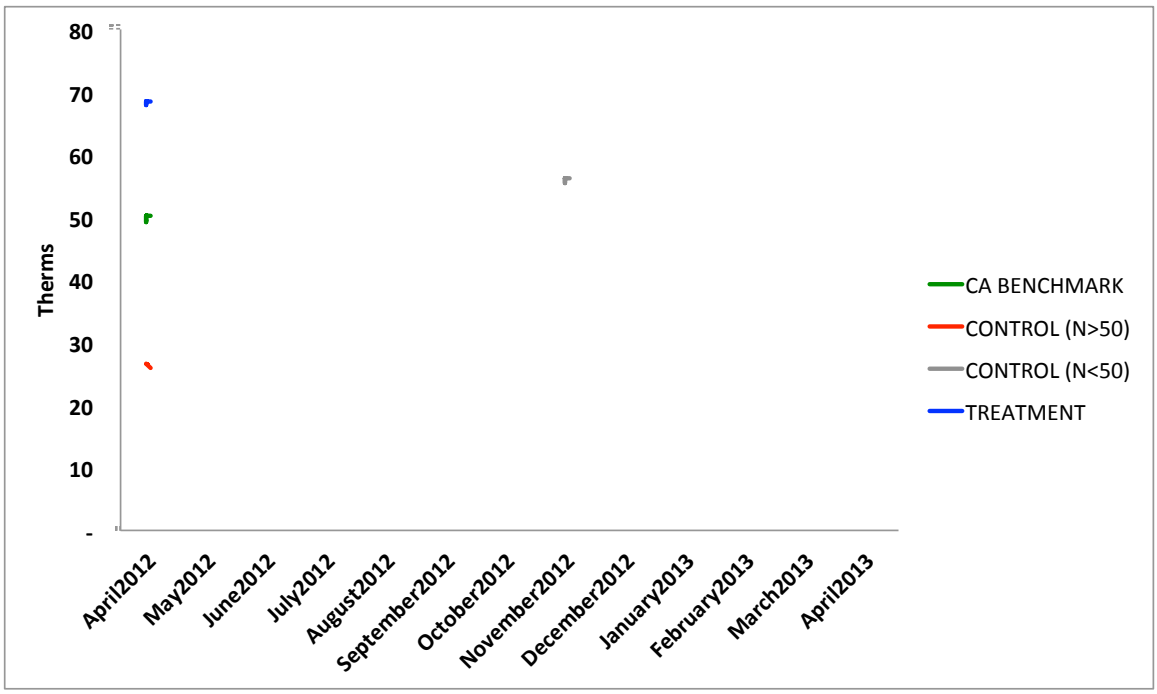

Figure . Natural Gas Consumption of Treatment and Control Group, and California Benchmark

Total Energy and CO_2 Savings

The analysis above considers only participating households that entered electricity or natural gas reports in any given month. Multiplying monthly electricity savings in each month by the number of reporting households, summed over the 13 months of the program translates to 183 MWh of electricity savings, equivalent to the average annual electricity consumption of 23 California homes, and about 50 metric tons of CO_2. This does not include any savings for active households when they did not report electricity or any potential savings from households not reporting electricity. It also does not include any potential savings from motor vehicles, which were not calculated for this study. An alternative method of determining CO_2 savings in real time during the program was to divide Bonus Points by 3 to account for reductions below participants' performance in previous months. Using this methodology we calculated a program-wide savings of about 495,000 lbs (227 metric tons) of CO_2, approximately reaching the stated goal of 500,000 announced several months prior to the end of the program.

4.3. Survey Results

In the figures below we provide descriptive results from the survey responses and compare points earned by different groups of subjects.

4.3.1. Demographic Characteristics

Nearly 50% more women completed the research survey than men (Figure 16). Online Challenge accounts were linked to one email address per household. We therefore assume that the person who completed the research survey was also likely to be responsible for administering the program within the household. Households in which men completed the research survey earned

an average of 33% more points than women who completed the survey; however, in total women earned 40% more points than men because women represented more of the participating households. Only 14% of participants who completed the survey were between the ages of 18 and 34. While this age group was initially an important target audience (mostly "striving believers"), young adults were more difficult to recruit into the program. Young people also scored, on average, less than half the points of participants in other age groups. This may partly be explained by the large fraction of young people who are likely renters, but it also may reflect lower levels of interest and participation generally. All other age groups earned a similar amount of points.

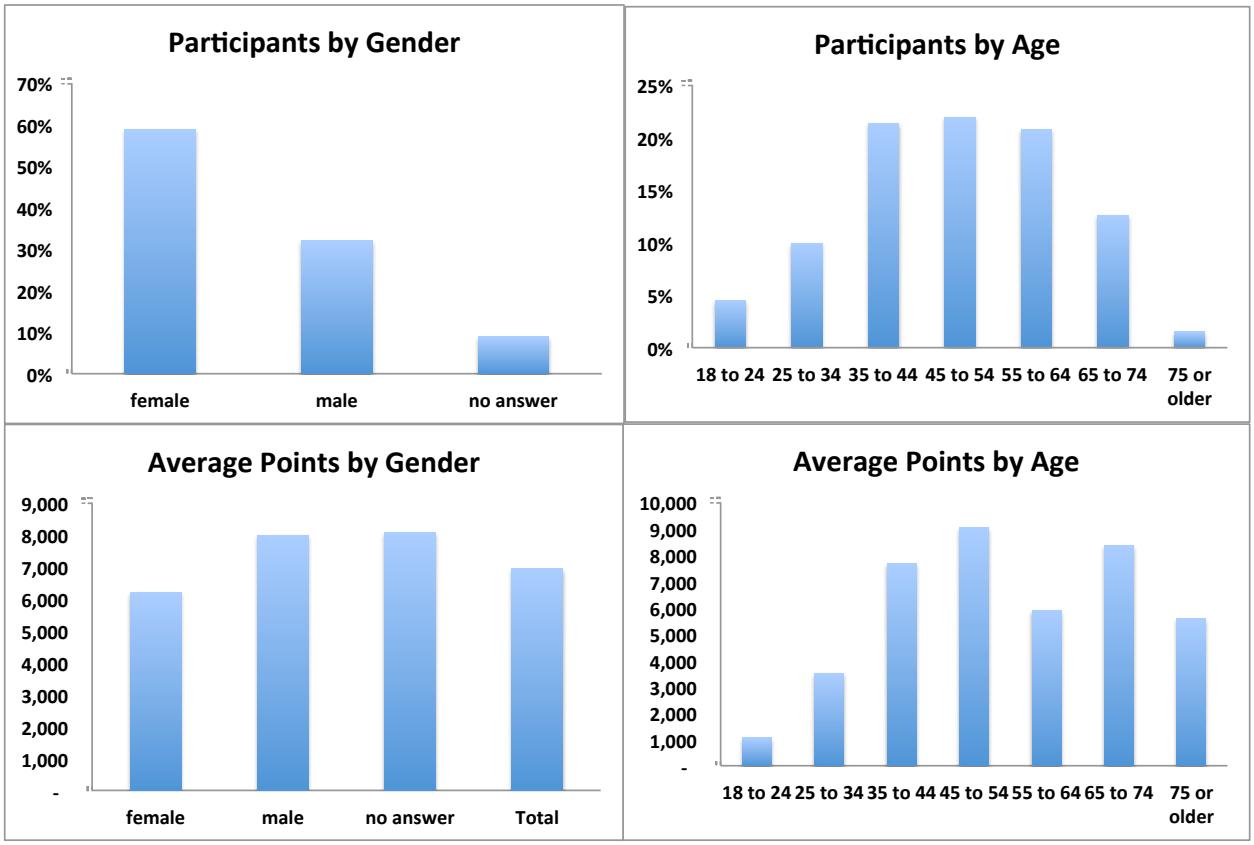

Figure 15 Points Earned by Sex and Age of Respondent

Figure 17 shows participation across income levels and education attainment. Participants were well represented across income levels and participants were only slightly more likely to earn points at higher incomes than at lower incomes. Education had a much stronger impact on points, with respondents who hold graduate degrees earning more than two times as many points as participants without a college degree.

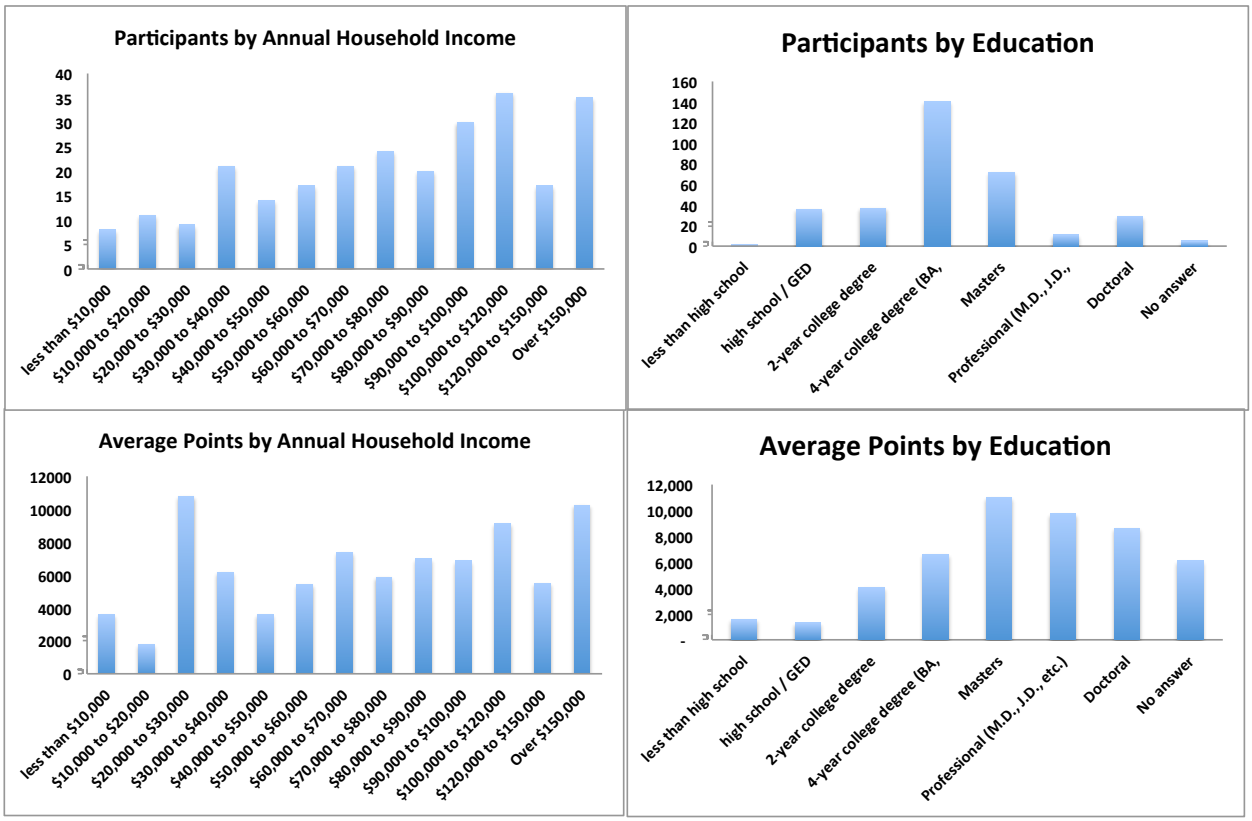

Figure 16. Participation and Average Points by Income and Education

Figure 18 shows participation levels and average points earned per household by level of conservatism and political party affiliation. As expected, most participants were politically liberal (76%) and Democrats (60%); however, 12% of those who answered this question self-identified as conservative and 14% as Republican. Somewhat surprisingly, conservatives and Republicans earned only about a third fewer points, on average per household, than liberals and Democrats.

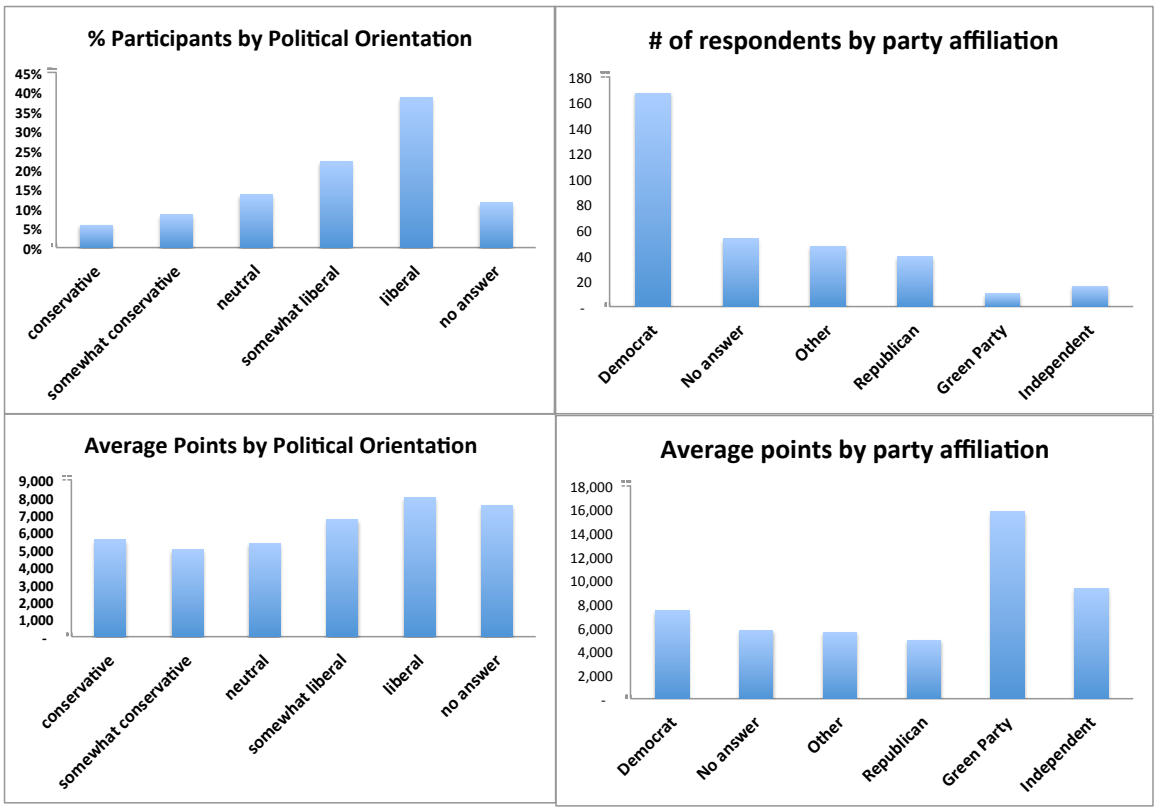

Figure 17. Participation and Average Points by Political Orientation and Political Party

A recent ARB-funded study (M. Delmas 2013; Chen, Delmas, and Kaiser 2014) providing energy feedback to residents of family student housing found that households with children reduced more energy than households without children. We were not able to replicate this finding in the Challenge (Figure 19); households without children earned more points than households with one or more children. However, in the previous ARB study, this finding was only robust in cases where households were receiving information about the health impacts of air pollution associated with electricity use so results are not directly comparable.

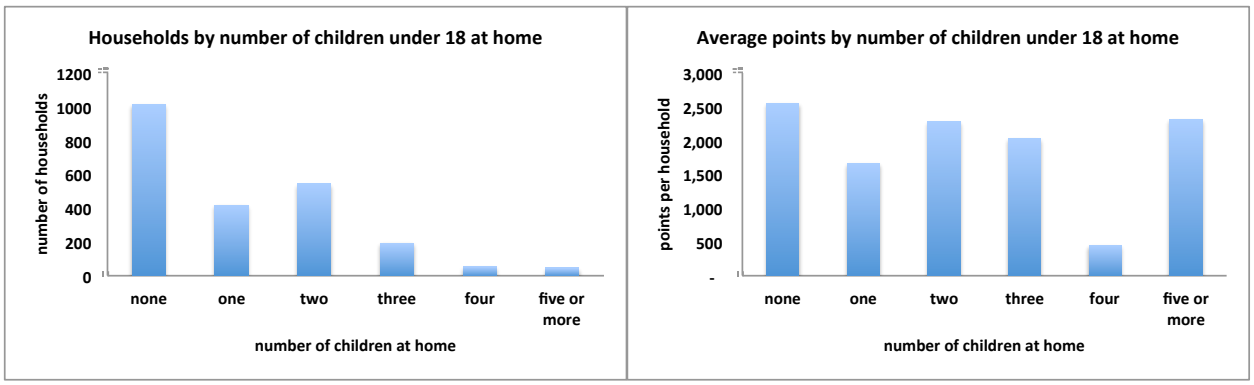

Figure 18. Number of Households and Points per Household by Number of Children at Home

4.3.2. Lifestyle & Behaviors

Most participants heard about the program from the city government or another participant, friend or colleague (Figure 20). This suggests that social networks and social diffusion were effective strategies to encourage program participation. While most survey respondents only checked one box, many noted that they heard about the program from multiple sources. It is possible that many respondents in fact heard about the program from multiple sources, but simply checked one box.

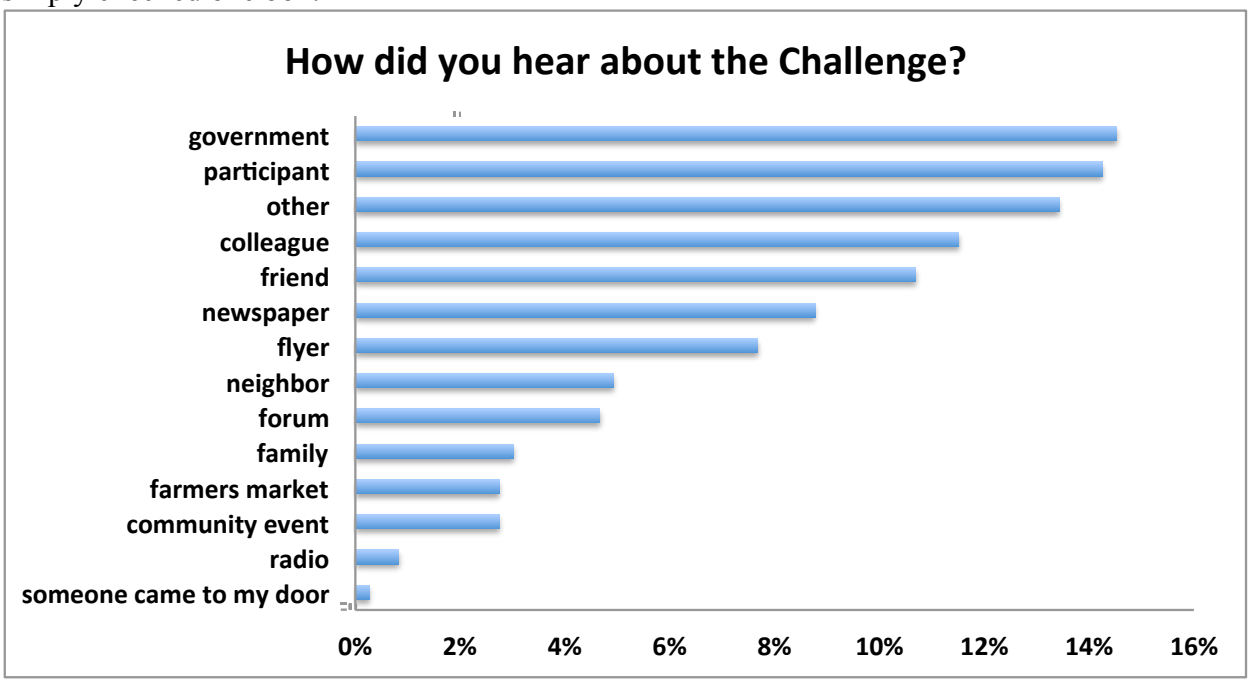

Figure 19. How Participants Heard About the Challenge

Respondents demonstrated strong pre-existing participation in low carbon lifestyles (Figure 21). Over 60% of respondents ride their bicycle at least once a week during nice weather and about 40% ride their bicycles even when the weather is not nice. About 50% of participants compost, presumably mostly in their own yards since curbside food waste collection for municipal composting is not available in participating cities. Sixty percent of participants eat a vegetarian meal at least once a week. Thus, the program seemed to attract households who have largely already taken a number of actions that the program recommends prior to joining.

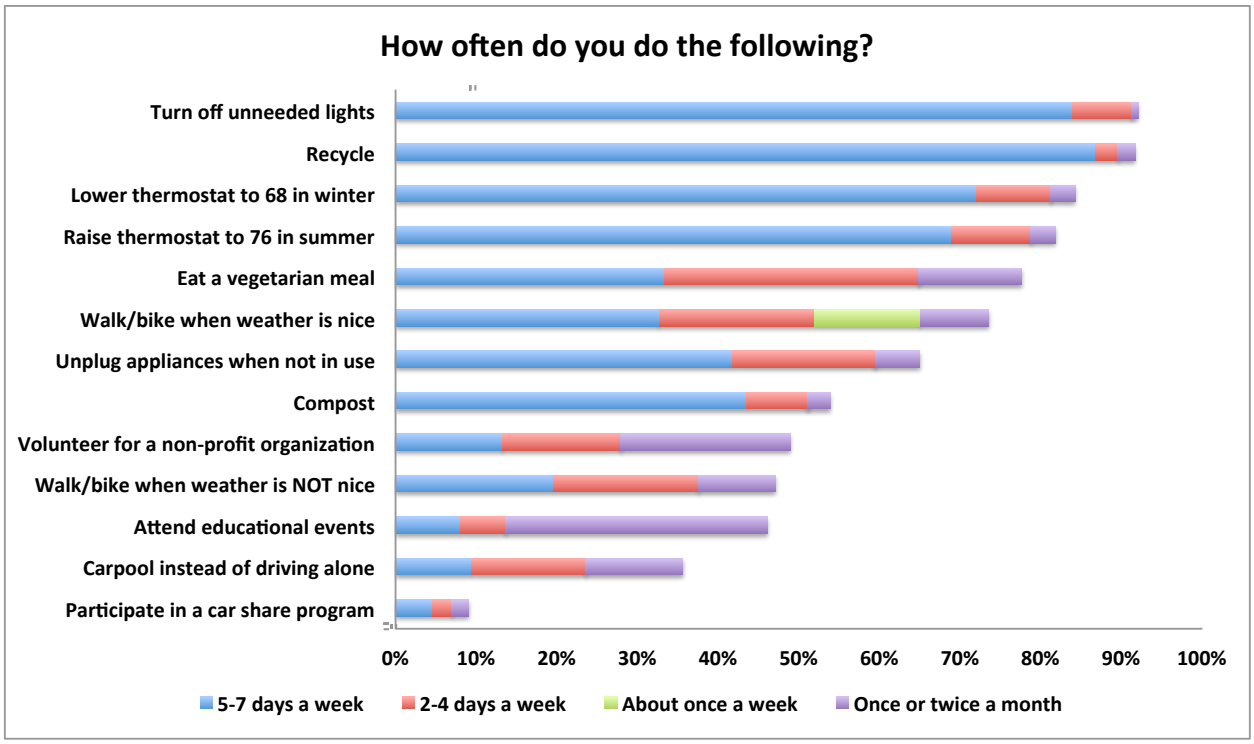

Figure 20. Low Carbon Practices of Participants

Far fewer respondents have purchased energy efficient products or appliances (Figure 22). While over 70% have purchased energy efficient light blubs, only 20% reported purchasing an energy-efficient appliance and less than 10% had insulated their attic, weather-stripped their home or installed an energy-efficient furnace, water heater or air conditioner.

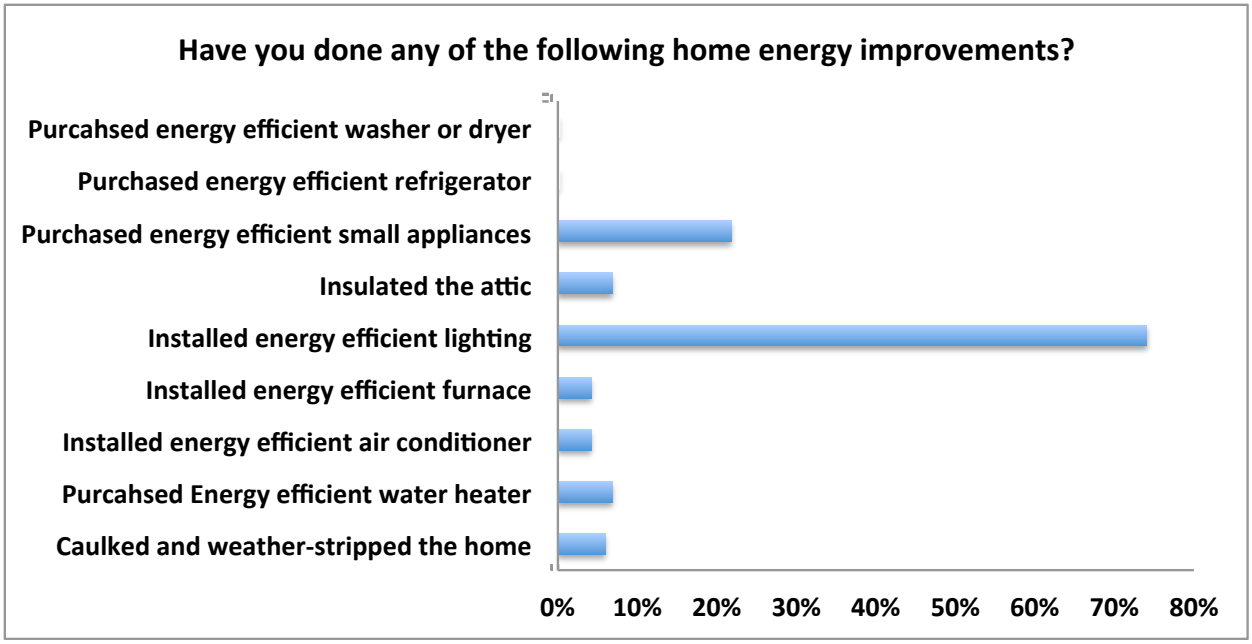

Figure 21. Energy Improvements Taken by Households

Over 30% of respondents owned a vehicle that gets over 30 miles per gallon and 15% owned either a hybrid electric, plug-in hybrid or all electric vehicle. Fifteen respondents even reported owning either an electric bicycle or a neighborhood electric vehicle. (Figure 23)

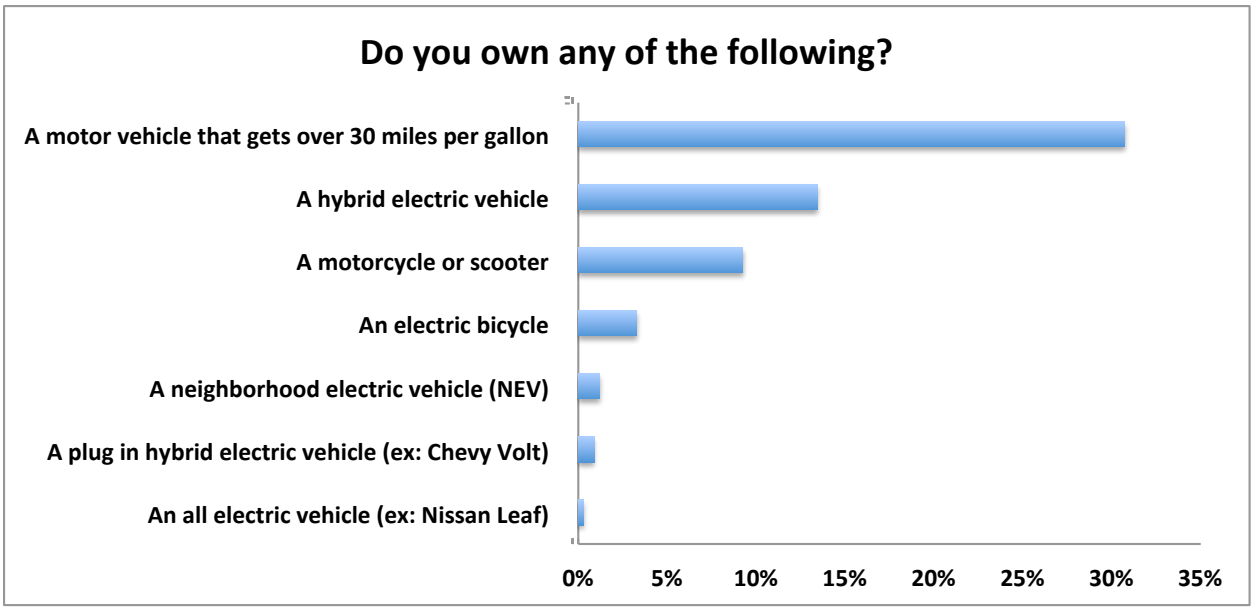

Figure 22. Ownership of Fuel Efficient and Electric Vehicles

4.3.3. Opinions and Attitudes

About 90% of respondents reported being either very well informed or fairly well informed about the causes of global warming and "ways in which we can reduce global warming" (Figure 24). Those who reported being very well informed earned over twice the number of points per household than those who were less informed about the causes of global warming and nearly three times as many points than those who were not well informed about personal actions to reduce global warming.

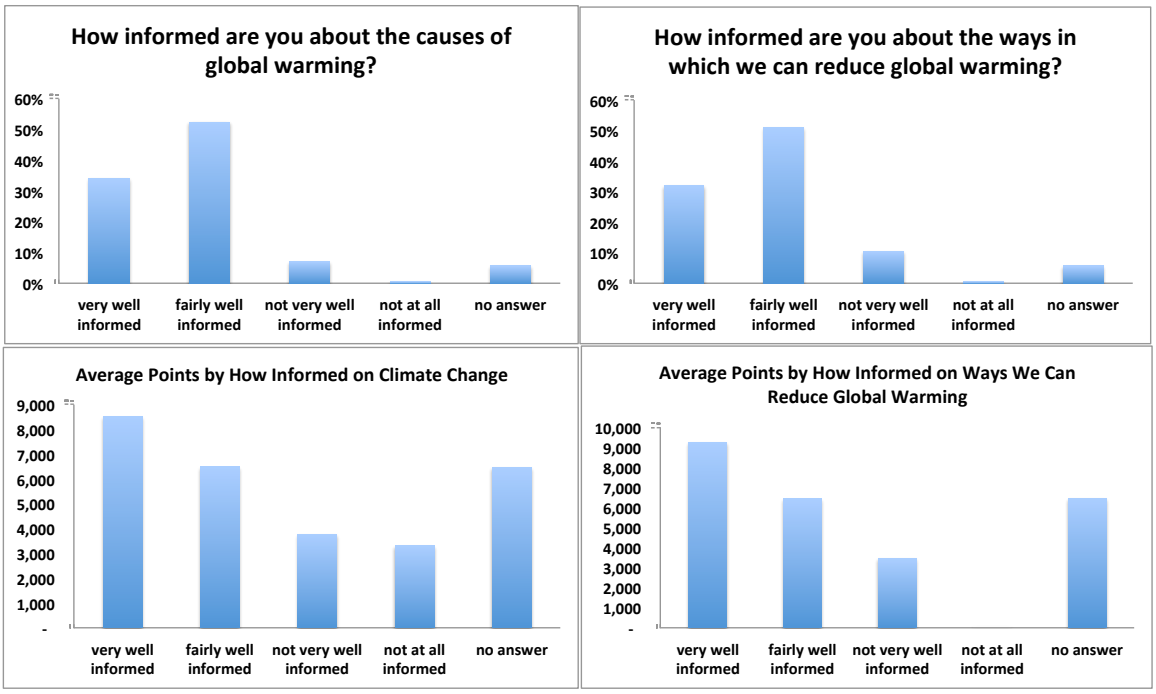

Figure 23. Participation and Points by Level of Information about Global Warming

Nearly 80% of respondents believed global warming is mostly caused by humans, while nearly 10% of respondents believed global warming was caused mostly by natural causes or that it was not happening (Figure 25). Surprisingly, those who were skeptical of human-induced global warming still earned about half as many points in the Challenge as those were convinced, reflecting a fairly high level of engagement in the program despite a clear lack of a climate change related motivation.

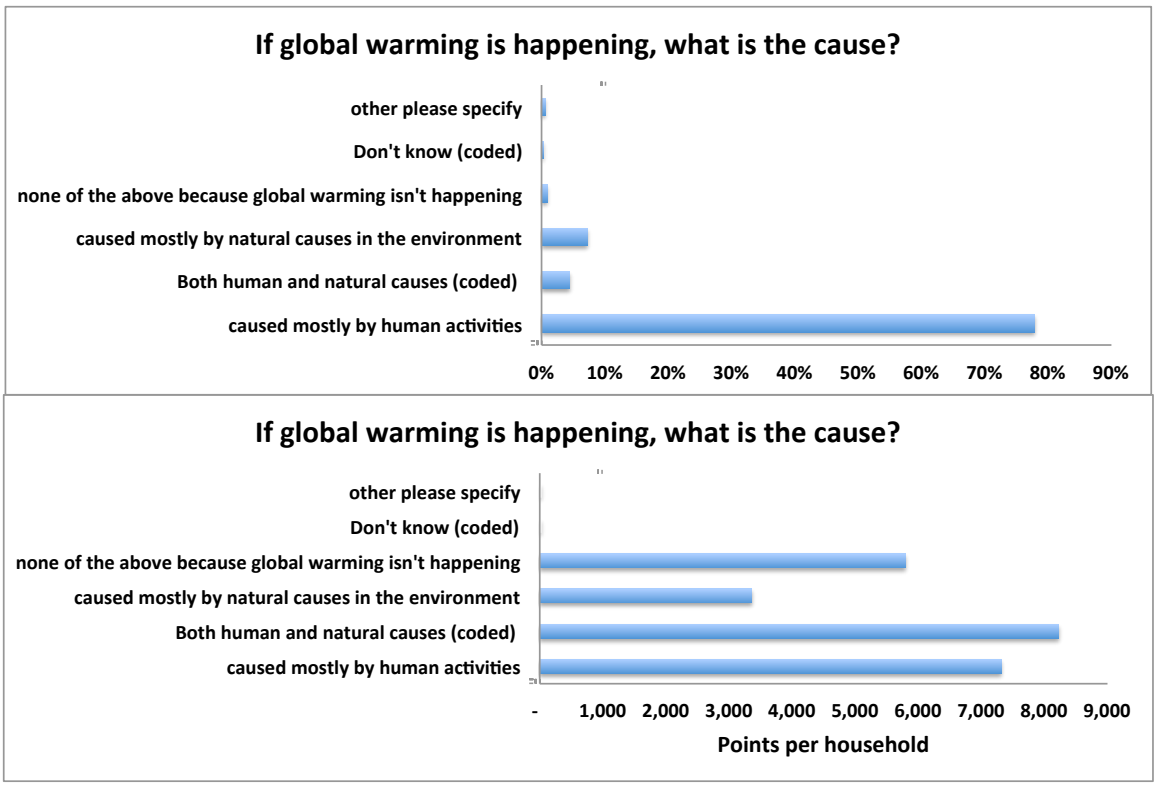

Figure 24. Belief in Human-Induced Global Warming

Most participants either agreed or strongly agreed that their actions "can make a difference to reduce global warming" (Figure 26); however, even those who did not agree or only somewhat agreed earned almost as many points per household.

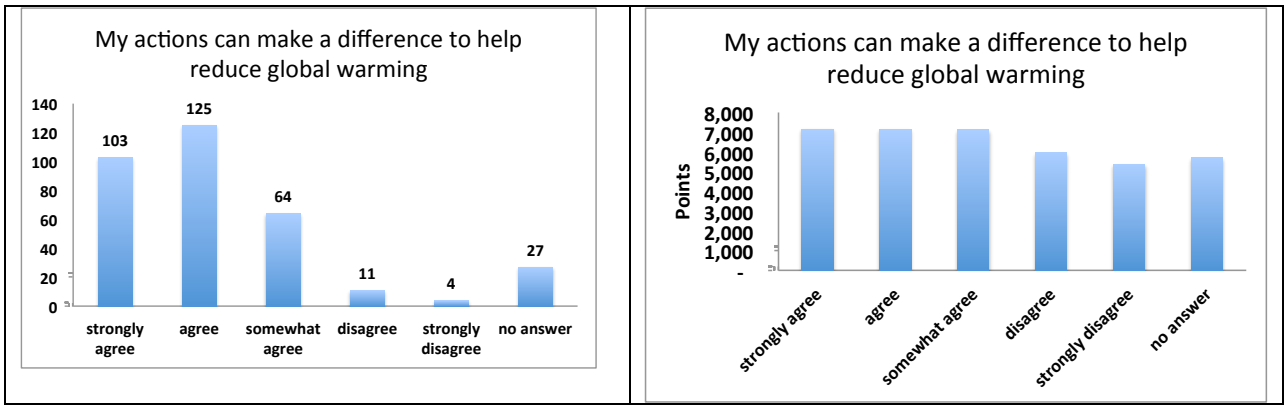

Figure 25. Belief that Their Actions Make a Difference

4.3.4. Primary Motivations and Values

Participants were asked to rate the importance of joining the Challenge from a list of motivations. Responses (Figure 27) reflect primarily altruistic and intrinsic motivations. Topping the list, with over 90% of respondents rating as at least somewhat important, were "improving where you live," "supporting organizations you care about" and "making an environmental statement." "Learning about new technologies" and "being part of something important" may also be considered intrinsic motivations, reflecting pleasure in understanding and participating in climate action. Extrinsic motivations of saving money and earning discounts also rated high; however, less than a third of participants ranked winning prizes as either important or very important. Living in a "Cool California city" and earning recognition for their city was either important or very important for over half of respondents.

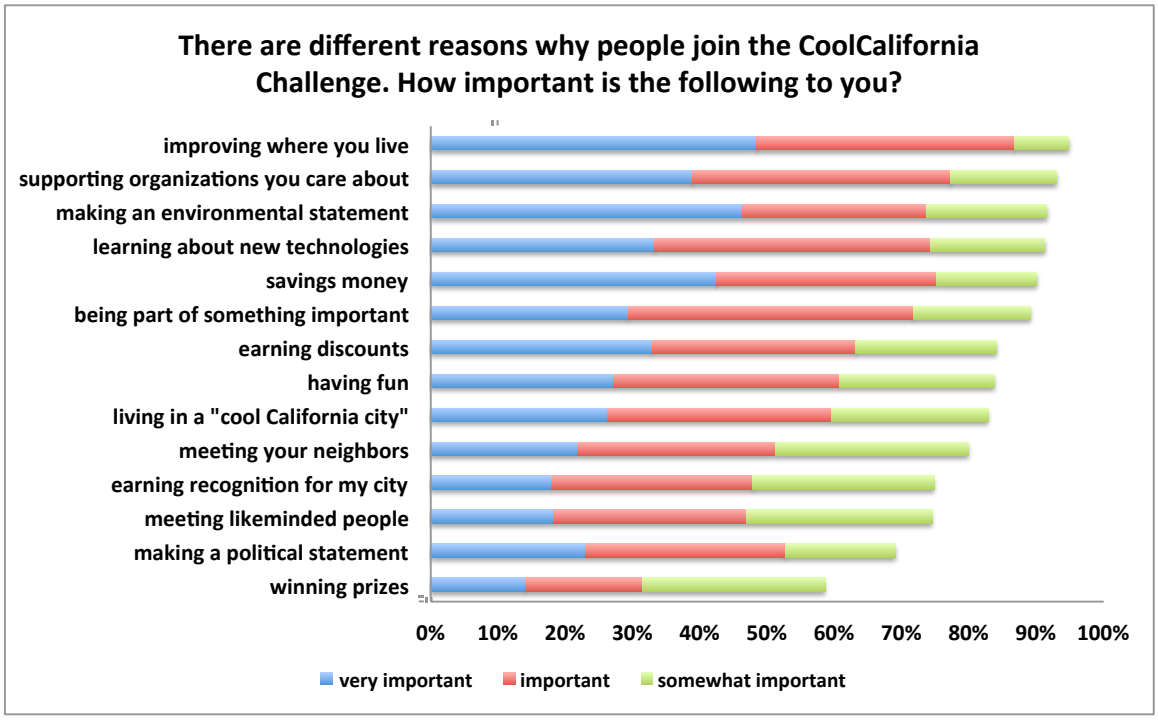

Figure 26. Primary Motivations for Joining the Challenge (all Participants)

Figure 28 compares motivations of participants based on different demographic characteristics, political party affiliation and belief in human-induced global warming. Answers were coded on a Likert scale from 0 (not important at all) to 4 (very important). There is remarkable consistency in the strength and rank of the top motivations across age, gender, income and education, although minor differences may be noticed. Young, less educated and lower income participants (who are often the same people) expressed slightly more interest in learning how to save money, receiving discounts and, somewhat more noticeably, winning prizes. "Having fun" rated slightly higher for participants under 35, although only marginally (3.1 vs 2.7). "Getting to know your neighbors" was slightly less important for men (2.3 vs. 2.7). Republicans and conservatives (combined as a single category) and "climate change skeptics" (lacking a belief in anthropogenic climate change) were also primarily motivated by helping their community and supporting

organizations they care about, although saving money was the highest-ranked motivation, making an environmental statement was not a top motivation, and making a political statement was not important (and potentially off-putting) for conservatives, as well as for less educated participants. Somewhat surprisingly, participants who signed up for the program but did not earn any points reported somewhat higher motivations than those who earned over 5,000 points (on average of 2.9 vs 2.7).

KEY	
Very important	4.0
Important	3.0
Somewhat important	2.0
Not very important	1.0
Not important at all	-

The following is a list of reasons why people are interested in joining the CoolCalifornia Challenge. How important is the following to you?

Motivation	All participants	Under 35 years old	Over 35 years old	Women	Men	Under $70k household income	Over $70k household income
Improving where you live	3.4	3.7	3.4	3.5	3.3	3.4	3.5
Making an environmental statement	3.2	3.0	3.3	3.3	3.1	3.2	3.2
Supporting organizations you care about	3.2	3.3	3.2	3.3	3.0	3.2	3.2
Learning how to save money	3.2	3.4	3.1	3.3	3.1	3.3	3.1
Learning about new technologies	3.1	3.0	3.1	3.1	3.1	3.1	3.0
Being part of something important	3.0	3.2	3.0	3.1	2.8	3.0	3.0
Receiving discounts for green products	2.9	3.1	2.8	2.9	2.8	2.9	2.7
Having fun	2.8	3.1	2.7	2.8	2.8	3.0	2.7
Living in a "Cool California City"	2.8	2.7	2.7	2.9	2.6	2.9	2.7
Getting to know your neighbors	2.6	2.6	2.6	2.7	2.3	2.7	2.6
Making a political statement	2.4	2.4	2.4	2.5	2.3	2.4	2.5
Meeting like-minded people	2.4	2.5	2.3	2.5	2.2	2.5	2.4
Receiving recognition for your city	2.4	2.6	2.3	2.5	2.1	2.5	2.4
Winning prizes	2.1	2.5	2.0	2.1	2.0	2.3	1.9
N	318	47	259	195	106	110	137

Motivation	Climate change skeptics	Republicans & Conservatives	Democrats & Liberals	Less than 4-yr degree	Hold advanced degree	Earned no Points	Earned over 5k Points
Improving where you live	3.2	3.4	3.5	3.4	3.4	3.5	3.4
Making an environmental statement	2.6	2.6	3.4	3.0	3.3	3.2	3.2
Supporting organizations you care about	3.0	3.1	3.3	3.0	3.3	3.1	3.1
Learning how to save money	3.3	3.4	3.1	3.4	2.9	3.3	3.0
Learning about new technologies	3.0	3.0	3.1	3.0	3.1	3.1	3.0
Being part of something important	2.6	2.8	3.1	2.9	3.0	3.0	3.0
Receiving discounts for green products	2.7	2.9	2.9	3.0	2.6	3.1	2.6
Having fun	2.7	3.0	2.7	2.9	2.7	2.9	2.6
Living in a "Cool California City"	2.5	2.6	2.8	2.8	2.7	2.8	2.6
Getting to know your neighbors	2.4	2.8	2.6	2.6	2.6	2.6	2.5
Making a political statement	1.5	1.6	2.7	1.9	2.8	2.3	2.5
Meeting like-minded people	1.9	2.1	2.5	2.3	2.4	2.4	2.3
Receiving recognition for your city	2.1	2.2	2.4	2.4	2.3	2.4	2.4
Winning prizes	2.0	2.2	2.0	2.4	1.9	2.3	2.0
N	42	41	230	69	108	139	111

Figure 27. Motivations for Program Participation by Demographic Characteristics

Participants were also asked about their values, which are thought to filter how information is perceived and frequently trigger an emotional response when activated (Schwartz). We used the consolidated Schwartz Values Survey (Lindeman and Verkasalo 2005), which includes a common list of universal values shared across cultures (see appendix B for a description of terms). Again, we see remarkable consistency between individuals, with universalism, self-

direction, security and benevolence as the top values for all groups, except conservatives, for whom tradition is also a core value. Power was at the bottom of the list, followed by prestige and hedonism, although hedonism (described as seeking pleasure) was an important value for people under 35. It is noteworthy that while hedonism is often a strongly held value for youth, "having fun" was not a primary motivation for joining the Challenge, perhaps indicating that they felt the program would not really be fun (although they were still motivated for altruistic reasons). See Figure 29.

KEY	
Extremely important	7.0
very important	6.0
	5.0
	4.0
important	3.0
somewhat important	2.0
not very important	1.0
not at all important	-

Please rate how important each value below is as a guiding principle in your life.

Human Value	All Participants	Under 35	55 or older	Women	Men	Under $40k personal	Over $70k personal
Universalism	5.3	5.2	5.3	5.6	5.0	5.5	5.4
Self-direction	5.1	5.5	4.8	5.2	5.1	5.1	5.2
Security	5.1	5.5	4.9	5.3	5.0	4.9	5.1
Benevolence	5.1	5.1	5.0	5.3	4.9	5.4	5.0
Tradition	3.9	3.9	3.6	4.0	3.6	3.7	3.8
Achievement	3.5	3.7	3.0	3.5	3.3	3.2	3.8
Conformity	3.0	2.8	2.8	2.8	3.0	2.8	3.1
Hedonism	2.5	3.2	2.1	2.3	2.5	2.3	2.4
Prestige	2.4	2.7	2.1	2.1	2.3	2.4	2.4
Power	1.8	1.9	1.4	1.5	1.6	1.6	1.8

Human Value	Conservatives	Liberals	Less than 4-yr degree	Advanced degree	Earned no Points	Over 5k Points	All Participants
Universalism	4.1	5.7	5.0	5.7	5.5	5.1	5.3
Self-direction	5.0	5.2	5.0	5.4	5.2	5.0	5.1
Security	5.7	5.0	5.8	5.0	5.3	4.8	5.1
Benevolence	4.6	5.3	5.1	5.3	5.1	5.0	5.1
Tradition	4.5	3.9	4.4	3.6	4.3	3.3	3.9
Achievement	3.0	3.7	3.1	3.8	3.6	3.3	3.5
Conformity	2.9	2.9	3.7	2.7	3.2	2.4	3.0
Hedonism	2.4	2.5	2.8	2.4	2.5	2.3	2.5
Social Status & Prestige	1.9	2.5	2.4	2.3	2.4	2.1	2.4
Power	1.3	2.0	2.0	1.6	1.8	1.6	1.8

Figure 28. Human Values by Demographics and Points

4.4. Participant Evaluation Surveys

Six months following the end of the CoolCalifornia Challenge participants were asked to complete the research survey for a second time. A new section on program evaluation was added, which asked questions on participants' experience with the program and recommendations for further program development. The following is a brief summary of results.

Participants were asked, “In what ways, if any, has the program changed your opinions about climate change or energy efficiency?” While this question did not explicitly ask about what actions participants had taken because of the program, ten respondents volunteered this information anyway, including: changing light bulbs, water heater, furnace, AC, solar panels, water tolerant plants, smart thermostats, new appliances, attic insulation, drying clothes on the line, and reducing idling. No one suggested that the program had changed his or her opinions of climate change or energy efficiency.

Over 70% of respondents rated the program as either Excellent or Good, while 20% rate the program as Fair and 7% rated the program as Poor or Fail (Figure 30). Opinions on the program website rated only slightly lower than the program overall, while less than 50% of respondents rated the program newsletters favorably. A large portion of participants either did not have communication with local program implementers or rated that communication as only fair.

Most respondents who rated the program unfavorably noted difficulty and frustration using the software. Several respondents said that they had problems inputting data and gave up. While the program did receive over 10,000 successful individual energy and vehicle reports, some users found the process to enter the data cumbersome, “clunky” or simply too difficult. A number of respondents requested that data be linked directly from utilities. Several also noted that they did not remember receiving newsletters or communication from the program, which may in fact have been the case since certain email providers frequently blocked email from the Challenge software.

The most common recommendations to improve the program were to make the program “easy and fun.” Several subjects wanted more personalized attention, including more community events, local stories, local communication and guidance. A number asked for simple, small daily or weekly challenges or tasks to keep people engaged. In contrast, others noted that the program should focus more on “fundamental change” with drastically different technologies, policies and lifestyle choices. As one participant noted, “you use the ‘simple ways to save the planet’ model. It isn’t simple.” Still others wanted very specific actions to be promoted, like cleaning solar panels or planting shade trees. One participant noted that the program should engage elementary schoolchildren. The diversity of these comments underscores the difficulty of trying to meet needs of a large range of stakeholders and population segments. It is impossible to please everyone. At the same time, the comments were extremely helpful to understand the diversity of needs and ideas to improve the program.

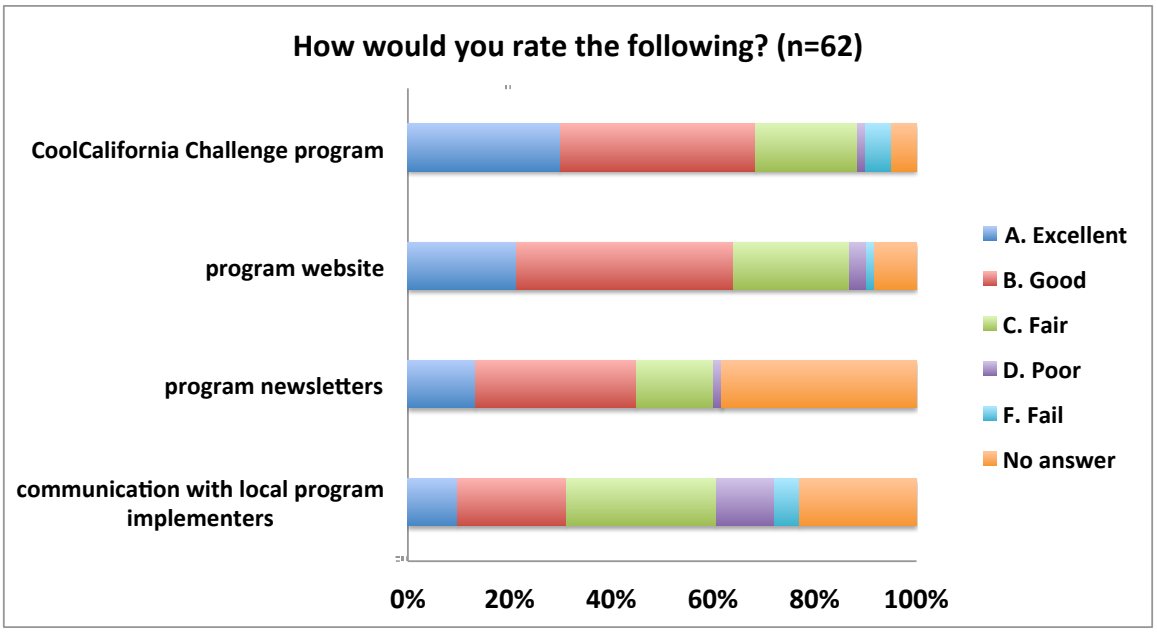

Figure 29. Participant Evaluation Survey Results: Project Ratings

4.5. Interviews with City Program Managers

The research team conducted interviews with six city program managers from four of the eight participating cities: Chula Vista, Davis, Sacramento and Tracy. City program managers from non-finalist cities did not complete the consent form to participate in the interviews. Subjects were asked questions on their city's original motivation for joining the Challenge, their goals and expectations and the extent to which those expectations were met, the resources contributed locally to run the program, the strategies employed, project outputs and outcomes, as well as recommendations for future program developers (See Appendix D for interview instrument). Below is a summary of findings from transcriptions of those interviews.

All participating cites, including those not interviewed, had recently completed climate action plans. While community engagement was frequently mentioned in these plans, they typically did not include specific recommendations or programs. Cities were largely interested in the Challenge as a way to fill this need. Even though the Challenge was marketed as a "pilot program" there was some expectation that it would be more fully developed and that cities would simply need to recruit participants. Some of the cities already had fairly robust community engagement programs, particularly Davis and Chula Vista, yet other cities were just starting their community engagement on climate and energy. Davis, the winning city, has a 30+ year history of community engagement on energy and the environment, and the Cool Davis program was created specifically to engage Davis residents and businesses in climate action. Similarly, the city of Chula Vista was one of the first cities to create a climate action plan and the local utility (SDG&E) funds city staff to design and implement community-scale energy efficiency campaigns.

Still, other less experienced cities, such as Tracy, were able to perform extremely well in the program by investing considerable staff and volunteer time to engage community members. The city had a small team of 5-6 staff conducting outreach in the community and messaging to participants, including a highly motivated local program manager who administered the program on top of her other responsibilities as city staff. While the city is not well known for its conservation efforts, the program manager noted that the most active people were already practicing energy efficiency and conservation practices; it was just a matter of finding and engaging them. The city also used seed money provided by the program to give out regular raffle prizes, including gift cards to local stores. In contrast, Davis, which has a strong history of engagement on energy conservation issues, did not use the raffle system. Overall, while experience and technical capacity of city program managers and core volunteers varied somewhat between cities, it was the dedication of staff and volunteers to the program, and not their experience, that seemed to be the most critical factor.

As the front line of engagement with participants, the city program managers were the first to receive program feedback. All of the city program managers mentioned some level of disappointment and frustration with the slow pace of software development. According to one subject, by the end of the program the software was at about "80%" of where they would have liked to be at the start of the program; had the program started at 80%, the program would have been much better. Some of the cities noted that they initially did not realize how much staff and volunteer time would be required of them to make the program a success in their community,

while another noted that they really did not have specific expectations but became heavily involved during months of intense competition. All cities noted that more financial support would have been helpful, but this ranged form a few thousand dollars to tens of thousands.

City program managers offered a number of suggestions. Common suggestions included more robust software and more support to city program staff and volunteers, either in-kind contributions or through additional funding. One of the cities stressed the importance of retaining complete contact information of participants during and after the program (cities were able to contact participants during the program via the software, but did not have direct access to their contact information). There was general agreement that the program should be well-planned in advance, giving cities sufficient time to prepare their strategies, and that the program and software should not change substantially during the program itself. All cities agreed that the program was too long and suggested a shorter campaign of between 4-9 months. While some liked the idea of targeting specific populations, particularly schools, they stressed the importance of having fully developed programs and long lead times to reduce barriers and make the program easier to implement.

Despite the fact that non-finalist cities did not participate in the interviews, it was clear from conversations during the program that motivation was low for cities that did not perform as well as the top cities. In some cases, city governments, including mayors, made personal appeals to motivate residents and there was some amount of embarrassment when cities did not perform well. An important lesson from this experience was that all cities should receive benefits from future programs, regardless of their ranking.

4.6. Research Hypotheses

This study was primarily exploratory and descriptive research, rather than theory-driven work designed to test an explicit hypothesis. Nonetheless, a number of operating hypotheses were tested, some of which were identified in the original research contract, and others that were added. A summary of hypotheses and results is presented in Appendix H. The most relevant study results are presented above and discussed below.

5. Discussion

Energy and GHG Savings

Participants tracking electricity saved an average of 14% compared to a control group, while no discernible savings were measured for natural gas. There are several plausible explanations for this difference. First, participation in the Challenge was greatly increased only during the most intense months of competition during the Qualifying Round (May through July, 2012) and the end of the Finalists Round (April through May, 2013) when there is much less demand (and opportunity to reduce) space and water heating. Electricity also supplies a larger number of end uses that may be easier to reduce through conservation than natural gas, which is primarily for space heating, water heating and cooking. For greenhouse gas reductions, lack of natural gas savings is particularly problematic since electricity is becoming less carbon intensive over time and will soon become a much smaller source of GHG emissions than natural gas for most California homes. A more targeted approach to identify and overcome barriers to adoption of natural gas conservation measures, applying competition strategies to motivate natural gas savings (e.g., a natural gas reduction goal and recognition for households meeting the goal) and shifting the timeline of the program to encourage more participation in winter months may be expected to lead to natural gas savings for future programs.

This study calculated savings of 183 MWh of electricity, equivalent to the average annual electricity consumption of 23 California homes and 50 metric tons of CO_2; however, this method only includes months for which we have a reasonable control group (April through October) and it does not include any savings from motor vehicles. Using an alternative methodology to calculate "bonus points" (see section 3.1.3) based on changes in participants' past reported performance for all months reporting electricity, natural gas and motor vehicles, the total savings were around 225 metric tons of CO_2, but this still does not include potential savings from households when not reporting. This large range of potential savings (50 to potentially over 225 metric tons of CO_2) highlights the challenge of quantifying results from opt-in household greenhouse gas reduction programs.This report only covers the pilot program. Future programs can be expected to have considerably higher savings as the program improves and becomes more cost-effective (see Appendix J).

Survey Results

Challenge participants were well represented across income brackets, but were primarily highly educated, politically liberal and middle-aged, with strong pre-existing pro-environmental attitudes and practices. Using the Opinion Dynamics population segmentation nomenclature, roughly 70% of active participants were "leading achievers," 20% were "striving believers" and 10% were "practical spenders." Young people were much less likely to enroll and to actively participate and earn points in the program, suggesting that future program interventions would need to be much more highly tailored to their needs in order to earn their engagement. While conservatives and "practical spenders" were less likely to enroll in the program, those who did performed well compared to more liberal counterparts. Education was an important factor; participants with advanced degrees earned two to three times more points than participants without a college degree. Considerable effort would be needed to actively engage populations with less formal education. The most active participants were "leading achievers" and "practical spenders," with "striving believers" straggling behind on points per household.

Households reported very altruistic and intrinsic motivations for participating in the program, with helping their community, making an environmental statement and supporting organizations they care about topping the list of motivations. Their values were also very much aligned with protecting the environment (universalism) and improving their communities (benevolence), regardless of political orientation or demographic characteristics.

Even though participants already had strong intrinsic motivation and largely led low carbon lifestyles, they demonstrated strong capacity to make further reductions during the program. Participants were most actively engaged in the program during the most intensive months of competition (summer 2012 and spring 2013), suggesting that competition is a useful strategy to catalyze participation and engagement.

Due to the small number of participants completing the survey during the program and 6-months post, and limited self-reported energy readings after completion of the program, we were not able to estimate persistence of behaviors or energy savings after completion of the program. Future program iterations could collect data directly from utilities, with permission from participants, in order to better evaluate persistence of behaviors and energy savings over time.

Participant Evaluation Survey Questions & Program Manager Exit Interviews

Participant survey data and interviews with program managers were helpful to understand what worked well and what elements of the program need improvement.

Participant approval ratings for the program (70% excellent or good, and 90% fair or better) were somewhat higher than expected given the pilot nature of the program and emerging software capabilities. A number of participants noted changes in behaviors and energy efficient equipment purchases that were at least in part due to the program.

While a number of participants expressed difficulties using the software, participants did successfully enter over 10,000 energy, motor vehicle or Kudo Points reports during the program, serving the primary purpose of the program well. By the end of the program the software had become quite sophisticated, providing feedback to participants entering data and facilitating communication with participants.

Local program managers, as well as program staff and researchers, provided a number of recommendations for future program development. A few of the most important recommendations are:

- Future programs should seek to increase motivation for all cities, even those not directly contending for top honors.
- Care should be taken to design programs to meet a wide range of needs from communities with different levels of capacity and diverse populations.
- In its current form the program has not able to successfully engage younger and less households. Future programs should develop targeted programs at youth and young adults living in shared housing to engage them more actively in the program.

- Programs should experimentally test different messages and intervention strategies to see which are more effective.
- Implementation of all community-based social marketing steps proved too time consuming for cities with limited program implementation capacity. Future programs should focus on a few behaviors common to all cities and develop program intervention that are tightly integrated with the statewide program rather than relying on each city to develop its own unique interventions. Interventions should be crafted following steps of community-based social marketing to select behaviors, identify barriers and motivations, use appropriate intervention strategies to highlight motivations and reduce barriers, test and disseminate.
- The length of the program should be shortened to prevent program fatigue from city program managers and participants. One tradeoff is a program covering summer months will have less opportunity for natural gas savings, while a winter program would have less opportunity for electricity savings and highlighting biking or outdoor activities and events.
- Additional funding or incentives would be required to engage communities more deeply in the program.
- The program software should be fully developed, engaging and easy to use.

6. Conclusion

The purpose of this study was to design, implement and evaluate an energy and carbon footprint reduction competition between residents of California cities. Program participants demonstrated higher than expected levels of participation and reductions in electricity consumption and greenhouse gas emissions during the program's pilot year. The program successfully engaged nearly 3,000 participants in 8 participating cities over the 13-month program, with 900 participants submitting over 10,000 monthly electricity, natural gas and motor vehicle reports.

The program appealed primarily to older, highly educated, more politically liberal households, although conservatives were also engaged and earned nearly as many points per household. Despite strong pre-existing intrinsic motivation to engage in low carbon practices, participants demonstrated capacity to make further reductions through their participation in the program.

Challenge participants saved an estimated 14% in electricity for those actively entering energy data in the software, which is encouraging given the pilot nature of the program. Future efforts could potentially expand these savings to a wider audience and achieve improved results.

The program did not result in measurable savings in natural gas. One possible explanation is the relatively low level of participation in the program (measured by new registrations and energy readings) during winter months when there were no deadlines or specific program objectives for participants or cities. Participants also tracked, and were encouraged to reduce motor vehicle usage; however, due to suspected reporting errors it was not possible to estimate reductions in vehicle travel or transportation greenhouse gas savings.

The element of competition proved to be a powerful motivator, with participation levels spiking only during moments of intense competition at the end of the Qualifying and Finalists rounds. One drawback of the competition model was cities that were not in contention for a finalist spot or winning the program had less motivation to engage in the program. Future program models should seek to increase motivation for all cities, even those not directly contending for top honors, and care should be taken to design programs to meet a wide range of needs from communities with different levels of capacity and diverse populations.

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Appendix A: Summary of key progress indicators and electricity data by city

This appendix contains key progress indicators for cities participating on the CoolCalifornia City Challenge pilot program (2012-2013). Table 1 presents key indicators for each participating city. Green, yellow and red colors indicate first, second and third place rankings, respectively, among the top three cities for each indicator.

Table 1. Summary of Key Progress Indicators by City

Energy and Total CO2 Savings

City	Total kWh	# kWh reports	Average kWh per month	Total Therms	# therms reports	Average therms per month	lbs CO2 saved (energy & driving bonus points / 3)	metric tons CO2 saved	Equivalent # homes taken off grid
Davis	323,846	1,019	318	27,048	998	27	129,562	59	24
Chula Vista	858,429	1,179	728	25,732	1,075	24	133,181	60	24
Tracy	412,372	717	575	22,167	676	33	75,695	34	14
Sacramento	152,947	412	371	10,896	324	34	27,996	13	5
Citrus Heights	72,048	145	497	3,228	129	25	16,649	8	3
Pleasanton	58,875	140	421	5,117	121	42	9,486	4	2
Pittsburg	61,301	138	444	3,462	138	25	16,502	7	3
San Jose	1,416,343	2,912	486	121,125	2,907	42	85,401	39	15
Santa Cruz	1,506	4	377	3	4	1	72	0	0
Total	**3,357,667**	**6,666**	**469**	**218,778**	**6,372**	**28**	**494,544**	**224**	**90**

Points

City	Total Green Points	Avg Green Pts / HH	Green points per reporting hh	Total Bonus Points	Avg Bonus Pts / HH	Bonus pts per active household	Total Kudos Points	Avg Kudos Pts / HH	Kudo Pts per active hh	Total Points	Avg Pts / HH	pts per active hh
Davis	1,206,726	2,749	7,057	388,686	885	2,273	120,835	275	707	1,716,247	3,909	10,037
Chula Vista	1,065,155	1,553	5,885	399,543	582	2,207	98,054	143	542	1,562,752	2,278	8,634
Tracy	663,382	1,741	5,183	227,086	596	1,774	66,441	174	519	956,909	2,512	7,476
Sacramento	203,593	676	1,697	83,989	279	700	51,467	171	429	339,049	1,126	2,825
Citrus Heights	60,498	455	1,407	49,948	376	1,162	25,400	191	591	135,846	1,021	3,159
Pleasanton	76,380	455	1,736	28,457	169	647	29,969	178	681	134,806	802	3,064
Pittsburg	82,583	810	2,503	49,505	485	1,500	9,199	90	279	122,889	1,205	3,724
San Jose	496,707	1,177	2,208	256,202	607	1,139	42,200	100	188	1,219,082	2,889	5,418
Santa Cruz	1,709	285	1,709	216	36	216	670	112	670	2,595	433	2,595
Total	**3,856,733**	**1,462**	**4,077**	**1,483,632**	**562**	**1,568**	**444,235**	**168**	**470**	**6,190,175**	**2,347**	**6,544**

Participants in the city of San Jose used proprietary software (Wattzon), while participants in all other cities used the Challenge software. There were several important differences between the two platforms. Most importantly, Wattzon connects to PG&E accounts directly so participants do not need to enter monthly energy data manually as in the Challenge software. This means that San Jose participants earned points every month regardless of their engagement with the software. At the same time, San Jose participants did not have the option to track automobiles. Given these differences in data collection, results for San Jose are not directly comparable to other cities.

Table 2. Electricity Mean, Standard Deviation and N of Treatment Group by City

MEAN

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	297	220	293	328	335	438	393	378	359	446	449	330	326	265
Davis	425	257	325	348	385	431	357	354	356	453	460	360	338	278
Sacramento	340	287	303	370	372	478	371	309	360	427	433	359	340	279
Tracy	428	399	396	472	389	459	400	388	378	469	457	387	373	325
Other City	290	297	348	358	397	481	416	369	370	469	457	394	383	322
Total	366	300	332	374	372	452	384	366	363	454	454	358	344	283

STANDARD DEVIATION

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	227	228	247	303	302	373	313	255	211	312	296	237	219	215
Davis	254	219	423	363	400	414	360	258	217	264	277	269	373	406
Sacramento	223	250	256	256	299	293	241	161	244	394	348	233	219	157
Tracy	233	230	242	330	346	393	385	388	296	302	297	280	360	395
Other City	288	284	211	255	280	262	193	146	160	200	175	211	304	421
Total	249	248	311	312	331	364	327	277	229	287	279	251	310	335

COUNT (N)

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	160	160	160	160	160	160	160	160	160	160	160	160	160	160
Davis	150	150	150	150	150	150	150	150	150	150	150	150	150	150
Sacramento	112	112	112	112	112	112	112	112	112	112	112	112	112	112
Tracy	122	122	122	122	122	122	122	122	122	122	122	122	122	122
Other City	117	117	117	117	117	117	117	117	117	117	117	117	117	117
Total	661	661	661	661	661	661	661	661	661	661	661	661	661	661

Table 3. Electricity Mean, Standard Deviation and N of Control Group by City

MEAN

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	351	343	334	408	550	540	438	363	400	542	484	477	446	391
Davis	298	352	325	484	462	813	724	534	554	682	495	484	439	302
Sacramento	350	365	350	413	478	487	484	444	435	884	653	457	690	537
Tracy	296	295	272	299	474	620	629	100	53	N/A	N/A	276	646	249
Other City	373	339	281	450	430	N/A	N/A	N/A	N/A	N/A	N/A	215	N/A	N/A
Total	331	338	312	393	503	581	506	381	421	591	495	455	466	358

STANDARD DEVIATION

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	198	199	200	288	303	297	266	185	171	164	128	226	197	193
Davis	330	304	372	752	360	586	770	611	447	424	408	292	332	245
Sacramento	222	274	204	391	236	534	332	435	393	N/A	N/A	44	N/A	N/A
Tracy	213	245	269	336	352	394	560	157	N/A	N/A	N/A	N/A	N/A	N/A
Other City	383	209	403	271	236	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total	286	246	279	390	310	418	424	297	259	256	245	224	248	207

COUNT (N)

City	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13
Chula Vista	57	66	74	79	33	31	37	55	22	17	16	12	10	10
Davis	60	64	22	22	19	9	11	7	6	6	8	5	7	7
Sacramento	22	35	26	11	10	12	11	12	2	1	1	2	1	1
Tracy	46	52	48	48	10	7	3	3	1	0	0	1	1	1
Other City	49	60	34	20	3	0	0	0	0	0	0	1	0	0
Total	234	277	204	180	75	59	62	77	31	24	25	21	19	19

Appendix B: CoolCalifornia Challenge - Participants Survey

Thank you for joining the CoolCalifornia Challenge and for agreeing to participate in this survey.

The purpose of the CoolCalifornia Challenge is to encourage Californians to adopt "greener," more environmentally friendly lifestyles.

The following survey will aid the research team in understanding the motivations of CoolCalifornia Challenge participants in order to enhance the program and contribute to behavioral and social science research.

Completion of this survey is completely voluntary. You will receive points in the CoolCalifornia Challenge for completing the survey. You may choose to skip any question in the survey that you do not wish to answer by selecting "no answer."

Please answer the following questions to the best of your ability. Your answers will greatly increase the effectiveness of this program.

Part A. Demographics

1. How old are you?

18 to 24
25 to 34
35 to 44
45 to 54
55 to 64
65 to 74
75 or older
No answer

2. What is your sex?

Male
Female
No answer

3. What is your annual household income and personal income?

- Your household income?
    - Less than $10,000
    - $10,000 to $20,000
    - $20,000 to $30,000
    - $30,000 to $40,000
    - $40,000 to $50,000
    - $50,000 to $60,000
    - $60,000 to $70,000
    - $70,000 to $80,000

    - $80,000 to $90,000
    - $90,000 to $100,000
    - $100,000 to $120,000
    - $120,000 to $150,000
    - Over $150,000
    - No answer
- Your personal income?
    - Less than $10,000
    - $10,000 to $20,000
    - $20,000 to $30,000
    - $30,000 to $40,000
    - $40,000 to $50,000
    - $50,000 to $60,000
    - $60,000 to $70,000
    - $70,000 to $80,000
    - $80,000 to $90,000
    - $90,000 to $100,000
    - $100,000 to $120,000
    - $120,000 to $150,000
    - Over $150,000
    - No answer

4. What is the highest level of education you have completed?
    - Less than high school
    - High school / GED
    - 2-year college degree (Associates)
    - 4-year college degree (B.A., B.S.)
    - Master (M.A., M.S., etc.)
    - Doctoral Ph.D.
    - Professional (M.D., J.D., etc.)
    - No answer

5. Generally speaking, do you think of yourself as politically conservative or liberal?
    - Conservative
    - Somewhat conservative
    - Neutral
    - Somewhat liberal
    - Liberal
    - No answer

6. Generally speaking, do you think of yourself as…
    - Republican
    - Democrat

- Other (please specify)
- No party / not interested in politics
- No answer

Part B. Lifestyle

7. How did you hear about the CoolCalifornia Challenge?
(check all that apply)

- A family member
- A friend
- A neighbor
- A colleague at work
- A classmate or teacher
- A contractor
- A community-based organization
- A community event or farmer's market
- A participant in the CoolCalifornia Challenge
- A public forum or meeting
- Television
- Radio
- Newspaper
- A flyer, brochure or poster
- Local government
- Someone came to my home

Other (please specify)

8. How often do you do the following?

- When the weather is nice outside, how often do you walk or bike instead of driving?
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- When the weather is not nice outside, how often do you walk or bike instead of driving?
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month

    - Never or rarely
    - No answer
- Carpool instead of driving alone
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Participate in a car share program
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Recycle
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Compost
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Eat a vegetarian meal
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Volunteer for a non-profit organization
    - 5-7 days a week
    - 2-4 days a week

    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Attend educational events
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Turn off unneeded lights
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- During summer, raise your thermostat to 76 degrees or higher
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- During winter, lower your thermostat to 68 degrees or cooler
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer
- Unplug appliances when not in use
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer

- Take public transit (bus, train, lightrail, subway, etc.)
    - 5-7 days a week
    - 2-4 days a week
    - About once a week
    - Once or twice a month
    - Less than once a month
    - Never or rarely
    - No answer

9. Have you done any of the following home energy improvements?
(check all that apply)

- Insulated your attic
- Caulked and weather-stripped your home
- Installed an energy efficient water heater
- Installed an energy efficient furnace
- Installed an energy efficient air conditioner
- Purchased energy efficient refrigerator
- Purchased energy efficient washer or dryer
- Purchased energy efficient small appliances
- Installed energy efficient lighting Installed energy efficient lighting Installed energy
- efficient lighting Installed energy efficient lighting

10. Do you own any of the following?
(check all that apply)

- A motor vehicle that gets over 30 miles per gallon
- A hybrid electric vehicle
- A plug in hybrid electric vehicle (ex: Chevy Volt)
- An all electric vehicle (ex: Nissan Leaf)
- A motorcycle or scooter
- An electric bicycle
- A neighborhood electric vehicle (NEV)

Part C. Opinions & Attitudes

11. How sure are you that global warming (or climate change) is happening?

- Extremely sure global warming is happening
- Very sure global warming is happening
- Somewhat sure global warming is happening
- Not at all sure global warming is happening
- Don't know
- Somewhat sure global warminig is not happening

- Very sure global warming is not happening
- Extremely sure global warming is not happening
- No answer

12. How worried are you about global warming?
    - Extemely worried
    - Very worried
    - Somewhat worried
    - Not very worried
    - Not at all worried
    - No answer

13. Personally, do you think you are well informed about...
    - ...the different causes of global warming
        - Very well informed
        - Fairly well informed
        - Not very well informed
        - Not at all informed
        - No answer
    - ...the different consequences of global warming
        - Very well informed
        - Fairly well informed
        - Not very well informed
        - Not at all informed
        - No answer
    - ...ways in which we can reduce global warming
        - Very well informed
        - Fairly well informed
        - Not very well informed
        - Not at all informed
        - No answer

14. If global warming is happening do you think it is:
    - Caused mostly by human activites
    - Caused mostly by natural causes in the environment
    - Other (please specify)
    - None of the above because global warming isn't happening
    - No answer

15. My actions can make a difference to help reduce global warming
    - Strongly agree
    - Agree
    - Somewhat agree

- Disagree
- Strongly disagree
- No answer

16. The following is a list of reasons why people are interested in joining the CoolCalifornia Challenge.

How important is the following to you?

- Living in a "Cool California City"
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Making an environmental statement with your actions
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Receiving recognition for your community
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Making a political statement
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Learning about new technologies
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer

- Meeting like-minded people
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Getting to know your neighbors
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Having fun
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Improving where you live
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Supporting organizations you care about
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Learning how to save money
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Receiving discounts for green products
    - Very important

    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Winning prizes
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Being part of something important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not important at all
    - No answer
- Other (please specify)

17. Taken all together, how would you say things are these days?
Would you say that you are:

- Very happy
- Pretty happy
- Not too happy
- No answer

18. Generally speaking, would you say that most people can be trusted or that you can't be too careful in dealing with people?

- People can be trusted
- You can't be too careful in dealing with people
- No answer

19. Please rate how important each value below is as a guiding principle in your life.

- Social status and prestige: recognition for your achievements
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer

- Power: Control or dominance over people and resources
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Achievement: Personal success through demonstrating competence according to social standards
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Hedonism: Pleasure and sensuous gratification for oneself.
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Self-direction: Independent thought and action—choosing, creating, exploring.
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Universalism: Understanding, appreciation, tolerance, and protection for the welfare of all people and for nature
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Benevolence: Preservation and enhancement of the welfare of people with whom one is in frequent personal contact.
    - Extremely important

    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Tradition: Respect, commitment, and acceptance of the customs and ideas that traditional culture or religion provide.
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Conformity: Restraint of actions, inclinations, and impulses likely to upset or harm others and violate social expectations or norms.
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer
- Security: Safety, harmony, and stability of society, of relationships, and of self.
    - Extremely important
    - Very important
    - Important
    - Somewhat important
    - Not very important
    - Not at all important
    - No answer

Appendix C. CoolCalifornia Challenge Program Evaluation

17. How would you rate the program website?
- A. Excellent
- B. Good
- C. Fair
- D. Poor
- F. Fail
- No answer

18. What improvements would you recommend for the website?

19. How would you rate the program newsletters?
- A. Excellent
- B. Good
- C. Fair
- D. Poor
- F. Fail
- No answer

20. What improvements would you recommend for the newsletters?

21. How would you rate the communication you have had with local program implementers?
- Excellent
- Good
- Fair
- Poor
- Fail
- No answer

22. What improvements would you recommend for local communication?

23. What energy efficient technologies, if any, did you purchase as a result of this program?

23. What energy conservation or low-carbon practices did you implement as a result of this program?

24. In what ways, if any, has the program changed your attitudes or opinions about climate change or
energy efficiency?

25. Overall, how would you rate the CoolCalifornia Challenge program?

- Excellent
- Good
- Fair
- Poor
- Fail
- No answer

26. What improvements would you recommend for the CoolCalifornia Challenge? (max length = 5,000 characters)

Appendix D: Program manager exit interview questions

Thank you very much for participating in this evaluation research for the CoolCalifornia Challenge pilot project. Your feedback is critically important to help U.C. Berkeley and the California Air Resources Board learn from your experience and to improve similar programs in the future.

This interview should take about 45 minutes but could be shorter or longer depending on the length of the answers you give. Feel free to answer the questions to the extent that you feel comfortable. I will be asking 26 questions, some with multiple parts.

As we mentioned in the consent form, I will be recording audio and later transcribing this interview to accurately capture our conversation. The research team will analyze the interviews and may include quotations or other results in future publications.

During this interview I will be asking about the following: a) the motivations, goals and expectations you had when your city joined the program, and to what extent those goals and expectations were or were not met through the pilot program, b) the target population and any relevant characteristics of participants in your city, c) the resources that were available locally, such as volunteer and staff time, as well as the resources provided by the program, including funding, support, and software; I will ask you to evaluate each of these separately, d) the activities and techniques used by the program, e) the specific project outputs, like newsletters, events, sign ups, energy readings, and raffle prizes, and f) the project outcomes, such as greenhouse gas reductions, awareness and local capacity. At the end of the interview you will also have a chance to tell me anything else you think would be useful for the evaluation of this program.

Do you have any questions? Are you ready to begin? OK, let's get started.

Identification

1. What was your role with the CoolCalifornia Challenge? For example, were you a local program manager or a volunteer?

2. What was your city's placement in the final rankings of the CoolCalifornia Challenge 2013?

A) Motivation, Goals, Expectations

3. Thinking back to when your city first joined the CoolCalifornia Challenge, what were the primary motivations of your city and/or your organizations to join and participate in the program?

4. What specifically did you seek to accomplish by participating in the program and to what extent were those expectations met?

B) Target Population

5. How would you describe Challenge participants in your community to a friend? You can include anything you think that would best characterize this group or groups of individuals.

6. Was this the target population you were originally seeking to engage? If not, how was the population different?

C) Inputs (Resources)

7. Who was primarily responsible for organizing the program at the local level?

8. What resources did the program organizers and/or other organizations in your community contribute? Resources typically include things like volunteer and staff time, funding, print materials, sponsorship, etc.

9. The CoolCalifornia Challenge statewide program sought to provide the following resources to cities: funding, program planning and logistical support, outreach and communications support, and software. I'd like to discuss each of these separately.

    a. Funding:
        i. Your city received (level of funding) in seed money and contributions. How did your organization use this funding?
        ii. Had more funding resources been available, what would have been your primary uses of this funding?
        iii. What would you consider an adequate level of funding to meet your expectations for the program?
    b. Program and logistics
        i. How involved was your city in planning the program?
        ii. Were your concerns heard and addressed?
        iii. Were biweekly calls beneficial? How could these be modified or improved?
        iv. What was your impression of the CBSM workshops? Were they helpful? How could they be improved?
    c. Outreach and communications. How would you evaluate the effectiveness of each of the following?
        i. Newsletters
        ii. E-mail communication with participants
        iii. Print materials
        iv. Interns
    d. Software
        i. The Challenge software was rolled out and changed throughout the one-year pilot project. How would you rate the software?
        ii. What were the aspects of the software that you liked and disliked most?
        iii. How could the software be improved?

iv. What else would you like to tell us about the software?

D) Actions - Activities

10. The Challenge pilot used a number of interventions strategies common with behavior programs, including prompts, persuasive messaging, goal setting, social diffusion, incentives and feedback. Which of these techniques do you find most effective with your target populations? What ideas do you have about improving the use of these strategies?

11. Your city conducted recruitment and outreach events. What did you find to be most effective, and what might you do differently?

12. The program focused primarily on newsletters and direct email communication with participants. How could communication with participants be improved?

13. Our goal with the points system were that it be fair, motivating and easy to understand. Do you think it met these goals? How could we improve the points system? Would simply awarding the winning city based on CO2 reduced make more sense?

E) Outputs

I'd like to discuss project outputs.

14. How many events did your community hold and what did these events entail?
15. Your city recorded ( ) energy and vehicle readings and () surveys. Are you satisfied with this level of participation?
16. Your city produced ( ) newsletters.
17. How would you evaluate the awards ceremony (ask only if participated)?

F) Outcomes

I'd like to discuss program outcomes.

18. Your city achieved ( ) pounds of greenhouse gas emissions. Are you satisfied with this level of reductions for the pilot?
19. To what extent did the program raise awareness of climate change and mitigation opportunities?
20. How did the city's outputs (events, printed materials, emails, etc.) encourage participation, raise awareness, or demonstrate GHG reductions?
21. To what extent was your community able to raise its own technical and organizational capacity to address community-wide greenhouse gas management through the Challenge?

22. To what extent was social cohesion improved in your community?

G) Other

23. I'd like to ask you a few questions about planning for Round II. What changes would you suggest for a successful program?

24. What would be the ideal timeline for your city?

25. Imagine the Challenge had three grand prizes of $20,000, $10,000 and $5,000 for 1st, 2nd and 3rd places respectively, in addition to $20,000 to distribute to cities based on new participants signed up by December 31. Additional sponsorship money would be distributed based on total points earned in each city at the end of the program. What do you think of this distribution of funds? Would it be better to distribute in some other way?

26. Is there anything else you would like us to know?

Appendix E: Screenshots of Challenge website

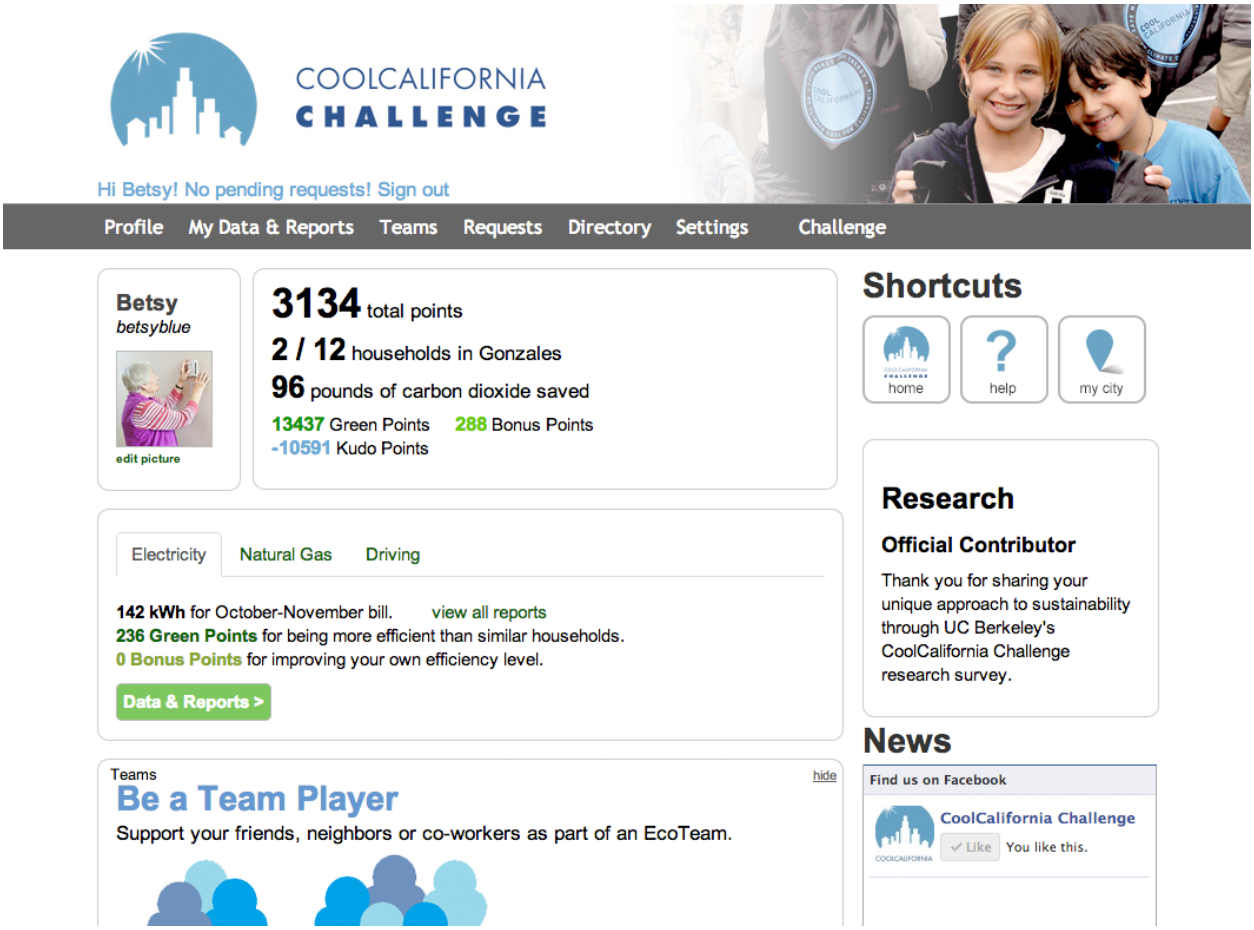


Figure 30. Screenshot of Sample User Profile Page

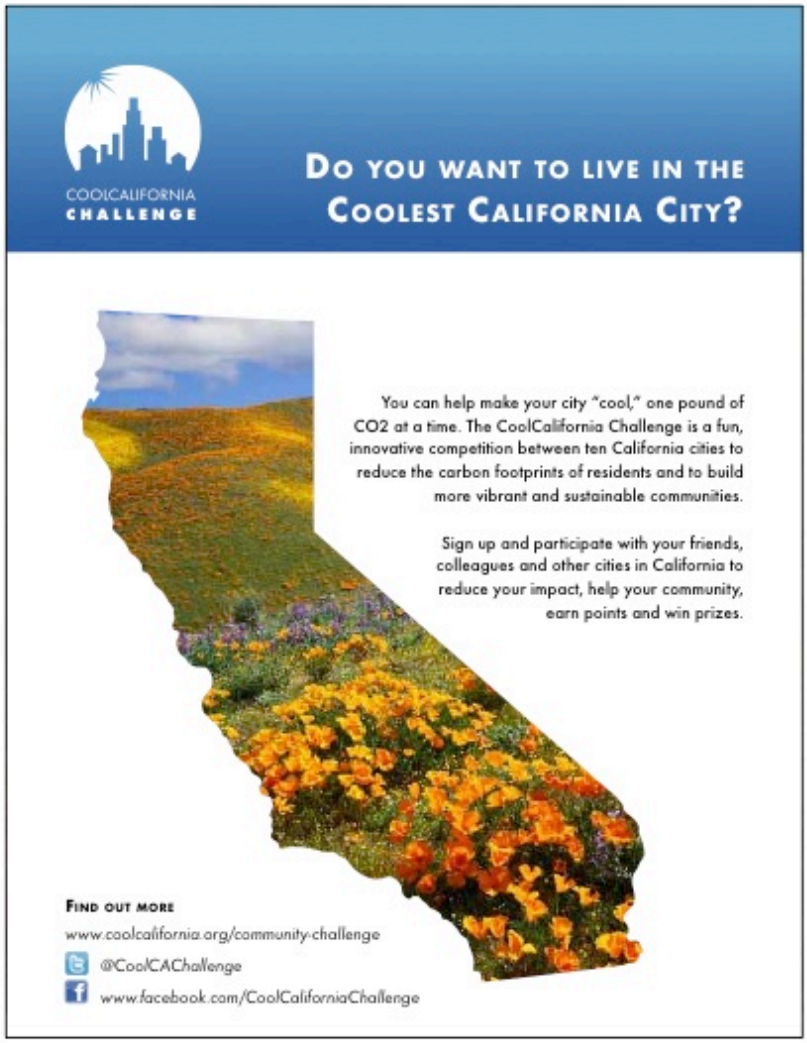
Figure 31. Screenshot of Sample Team Page

Figure 32. Screenshot of Final Scoreboard

Appendix F: Example program materials

City Flyer/Letterhead - *Sacramento*

Outreach Flyer



You can help make your city cool, one pound of CO2 at a time. The CoolCalifornia Challenge is a fun, innovative competition between ten California cities to reduce their community-wide carbon footprints and build more vibrant and sustainable communities. Sign up and participate with your friends,colleagues and other cities in California to reduce your impact, help your community, earn points and win prizes.

COOLCALIFORNIA
CHALLENGE

Join Today!

www.coolcalifornia.org/community-challenge

www.facebook.com/CoolCaliforniaChallenge

@CoolCAChallenge

Ahora puedes ayudar a tu ciudad a ser "cool", una libra de CO_2 menos cada vez. El Desafío CoolCalifornia es una competición divertida e innovadora entre 10 ciudades de California para reducir la huella de carbono de sus residentes y para construir comunidades más dinámicas y sostenibles. Regístrate y participa con tus amigos, colegas y con otras ciudades de California para reducir tu impacto ambiental, ayudar a tu comunidad y ganar puntos y premios.

COOLCALIFORNIA
CHALLENGE

¿Quieres saber más?

www.coolcalifornia.org/community-challenge

www.facebook.com/CoolCaliforniaChallenge

@CoolCAChallenge


Davis, CA
2013
COOLEST
CALIFORNIA CITY
The CoolCalifornia Challenge · 1st Place


Chula Vista, CA
2013
COOL
CALIFORNIA CITY
The CoolCalifornia Challenge · 2nd Place


Tracy, CA
2013
COOL
CALIFORNIA CITY
The CoolCalifornia Challenge · 3rd Place

Appendix G. Note on changes to original program design

The original research contract between U.C. Berkeley and the California Air Resources Board (#10-325) called for a different program design and research hypotheses than outlined in this report. This note briefly explains major changes, why these changes were made, while Appendix H summarizes the extent to which original research hypotheses were tested as a result.

The study was originally designed in contract 10-325 as a yearlong competition between three cities. Cities would be chosen based on their prior experience engaging residents in sustainability. These innovative cities would each receive $12,000 in initial seed money and would lend their experience to help design the program over a six-month long "Phase 0," and implement programs locally over one year. Additional seed money would be sought from project sponsors. Participants would be required to complete an initial research survey and agree to provide access to their energy data and other reporting requirements agreed to by cities. Participants would also complete an exit survey and a survey 6 months after the end of the competition.

Very early in the contract period ARB and U.C. Berkeley agreed to substantial changes to the program design. Due to concerns that the three chosen cities would not be representative of the California population it was not clear that lessons could be transferred to other communities. At the same time it was understood technologies and practices typically start with innovators and then early adopters (Rogers Everett's Diffusion of Innovations hypothesis). In order to resolve this conflict the parties agreed to an open statewide competition, allowing any California city the opportunity to compete. This model had the advantages of being more fair, allowing a broader representation of California cities to join (including innovative cities), and the ability to crown the winner the "Coolest California City," providing additional motivation for cities to join and participate.

The tradeoff of this open competition model was the loss of the ability of U.C. Berkeley to work directly with a small number of cities to develop and test targeted behavior interventions in each city. In part to help ameliorate this tradeoff the new program design included a "Qualifying Round" during which all cities would compete during 3 months, after which only the finalists would continue for the remainder of the program. However, U.C. Berkeley researchers would not be able to work directly with Finalists until almost a full year after the start of the research contract, limiting the ability to design robust interventions for specific populations in each of the three cities.

A second major change to the program design was U.C. Berkeley researchers were not allowed to require participants to take research surveys in order to participate in the program. U.C. Berkeley's Office of Protection of Human Subjects did not allow this since this would cause harm to those who sought to participate in the program, but were not willing to participate in the the research aspects of the program. As a result, participants were allowed to sign up without taking the research survey, thus limiting the availability of data collected by the research team from all participants.

A third major change was the need to develop sophisticated software to run the statewide competition. In the original design the three participating cities would help with data collection, and only relatively minor changes were envisioned to the existing CoolCalifornia carbon calculator. The new design required a robust and complex software system, including the ability to manually record energy and vehicle odometer readings, uploading photos and stories, communication with participants, raffles, creating and managing teams, calculating points for households, teams and cities and providing program-related content to participants. Only the most basic and essential functionality was ready by the start of the program, while other features were rolled out throughout the yearlong program.

Appendix H. Summary of results for research hypotheses

Hypotheses in the original research contract:

a. Program participants will reduce their absolute carbon footprints compared to their baseline assessment.

- Participants used an average of 14% less electricity than the control group, and about the same amount of natural gas.
- Only the electricity and natural gas savings were calculated, not savings from motor vehicles or other aspects of carbon footprints, e.g., food.
- Total greenhouse gas savings from electricity were calculated at 50 metric tons CO_2. Program-wide greenhouse gas savings calculated by the software as "bonus points" were 227 metric tons (~500,000 lbs CO_2).

b. Participants will report being more motivated by social incentives (recognition) and environmental incentives (doing the right thing) than by financial incentives (monetary value of prizes).

- True. Participants did not enroll and participate for the chance to receive a prize (prizes ranked last on a list of 14 motivations). They were primarily motivated to improve where they live, support organizations they care about and help protect the environment.
- However, there appears some discrepancy between what participants report and what is observed (e.g., more vigorous participation during intense competition).

c. Lower-income households will exhibit more financial motivations to participate.

- True, although the effect was not large.
- Conservatives and less educated participants also expressed somewhat higher financial motivations.

d. Participants in EcoTeams will reduce more than participants not in EcoTeams.

- EcoTeams were not sufficiently studied because the teams feature of the software was added too late in the program.

e. Program participants with prior relationships and greater expectation of future interactions with other program participants will reduce more than participants without strong pre-existing social connections.

- EcoTeams were not sufficiently studied because the teams feature of the software was added too late in the program.

f. Those with more altruistic environmental motivations for participating will have lower starting carbon footprints than participants with primarily social and financial motivations for participating.

- This was not studied due to the difficulty of tabulating the results for each of the roughly 10,000 individual electricity, natural gas and motor vehicle reports.

g. Program participants with higher starting carbon footprints will reduce more than households with lower carbon footprints.

- This was not studied due to the difficulty of tabulating the results for each of the roughly 10,000 individual electricity, natural gas and motor vehicle reports.

h. Households and communities with higher carbon footprints will reduce more, in absolute terms and as a percentage, than households with lower carbon footprints due to the prevalence of "low-hanging-fruit" actions and comparison with peers.

- This was not studied due to the difficulty of tabulating the results for each of the roughly 10,000 individual electricity, natural gas and motor vehicle reports.

i. Communities will achieve roughly similar results overall.

- False. Non-finalist cities (except San Jose, which used a separate proprietary software platform and can not be directly compared), did not achieve nearly as many points as finalist cities.

j. Savings will persist over time

- Since we did not have access to energy data for participants after the program we could not evaluate persistence. The follow up survey 6 months following the end of the program provided insufficient evidence for persistence of behaviors.

Additional hypotheses tested:

k. The program will appeal almost exclusively to liberal environmentalists.

- False. While most participants tended to be fairly well informed about the causes and consequences of climate change (per self-reported responses), and also were more likely to be politically liberal and highly educated (both strong determinants of pro-environmental beliefs and actions) over 30% of participants were politically conservative or neutral and earned nearly as many points per household as liberals.

l. The program will appeal mostly to young people who tend to be more interested in online games.

- False. Only 15% of participants were under 35 and young persons earned fewer points per household than older participants.

m. Households with children will earn more points than households without children since they will be more interested in the health and well-being of their children and future generations.

- False. Households without children earned more points on average than households with children. This is possibly due to the larger number of seniors in the program and lack of messaging on health benefits (as in the Delmas et al, 2013 study).

n. Participants will primarily be interested in receiving recognition for their city and prizes for themselves (both extrinsic motivations).

- False. Earning recognition for cities ranked 11 out of 14 motivations and earning prizes ranked last. Participants were primarily interested in improving where they live, supporting organizations they care about and making an environmental statement

o. Participants will have primarily universalistic values (defined as understanding, appreciation, tolerance, and protection for the welfare of all people and for nature).

- False. While universalism was the highest rated value overall, self-direction, security and benevolence were also strong values.

p. Manually entering energy data will be a major barrier preventing broad participation in the program.

- False. Over 900 households successfully manually entered over 10,000 individual electricity, natural gas, odometer readings and "kudo points" reports.

q. Households for which energy data are automatically received by software will reduce more energy since they will be able to focus on reductions rather than entering data as the primary means of participation.

- This appears to be false. The city of San Jose was the only city to have data automatically imported into a software platform (in this case the Wattzon platform), but San Jose participants earned only 1,139 Bonus Points per active household compared to an average of 1,568 Bonus Points per active household, on average, and over 2,200 Bonus Points per active households in Davis and Chula Vista. Bonus Points are calculated as CO_2 savings compared to the household's previous consumption, adjusting for weather. Active households are defined as households with more than one month of energy data. This is not a truly fair comparison since the Wattzon platform used by San Jose did not include motor vehicles; however, San Jose participants had data for all 13 months for all active households, while other Challenge participants only had data for those months in which they reported data (an average of 5 months per active household). The Wattzon software platform used by San Jose participants was also fundamentally

different than the Challenge software in many ways so comparisons are not really appropriate (and are therefore not addressed in the study).

- It may be that manually entering data each month is a prompt to reduce energy and a way to demonstrate active engagement with the program.
- Future programs should experimentally test manual data entry and automated data entry in order to test the efficacy of both approaches.

Appendix I. Analysis of results with and without Davis

The winning city, Davis, is a university town with a highly educated population. As shown in Figure 8, over 50% of Challenge participants from Davis filling out the survey have a graduate degree. It is reasonable to ask whether removing Davis participants from the analysis would affect all of the study results, and not just the energy savings. This section briefly explores removing Davis participants from the analysis of survey results and the impact this has on results.

As shown in Figure 33, excluding Davis from the results does not affect the results for key survey results, including average points by graduate degree, sex or political party.

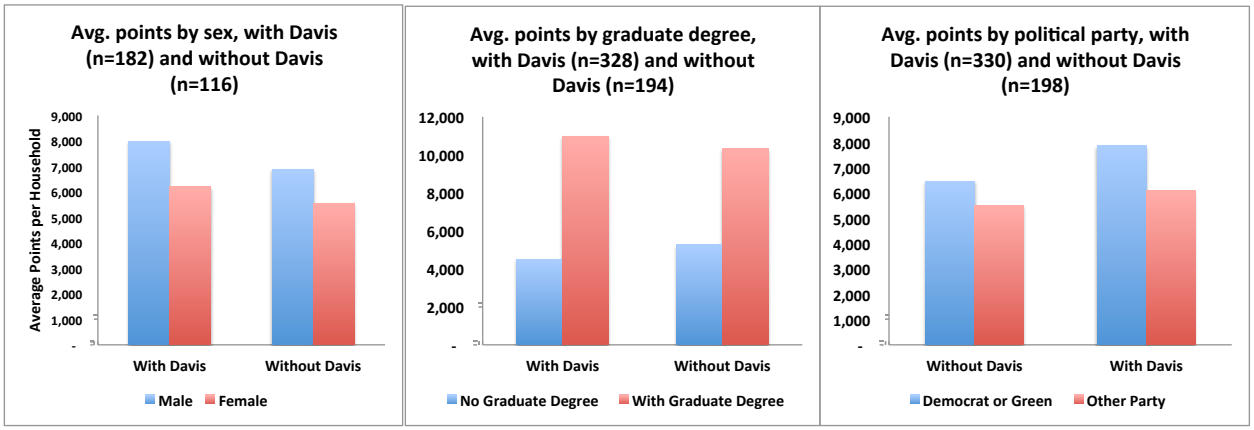


Figure 33. Average Points by Sex, Graduate Degree and Political Party, With or Without Davis

Appendix J: Project budget overview

The budget below contains all expenses for the design, implementation and evaluation of the CoolCalifornia City Challenge pilot project 2012-2103, not including in-kind contributions from cities and volunteers.

2012-2013 TOTAL PROJECT BUDGET		**$**	**432,504**
California Air Resources Board		**$**	**300,004**
1	Labor & Employee Fringe Benefits	$	226,223
2	Seed and prize money to cities	$	36,000
3	Travel & Subsistence	$	4,520
4	Photocopying & Printing	$	2,875
5	Mail, Telephone, and Fax	$	4,371
6	Materials & Supplies	$	1,250
7	Awards	$	1,000
8	Indirect Cost	$	23,765
Renewable and Appropriate Energy Laboratory		**$**	**100,000**
1	Software designer and manager	$	65,000
2	Student programmers	$	35,000
Next Ten		**$**	**5,000**
1	External software developer	$	5,000
Pacific Gas & Electric		**$**	**27,500**
1	Seed money to cities ($2,500 x 7 cities)	$	17,500
2	Program support (software)	$	10,000
Breakdown by task		**$**	**432,504**
1	Program design, implementation and evaluation	$	240,239
2	Funding to cities	$	53,500
3	Software	$	115,000
4	Indirect cost	$	23,765

Budget for 2014 Competition

At the time of this writing, Round 2 of the CoolCalifornia City Challenge is now complete. The program achieved 40% higher participation (3,775 households) and preliminary calculations indicate that Round 2 achieved 60% more CO_2 savings as calculated by Bonus Points (360 metric tons CO_2 compared to 225) in half the time (six months) and less than half the budget. The program also engaged ten very diverse cities, lending evidence that the program model is highly scalable to cities across California.

The total project budget for the CoolCalifornia City Challenge in 2014 was $150,000, including $100,000 in seed and prize money to cities from Energy Upgrade California and $50,000 in project management and software development for U.C. Berkeley (funding also from Energy Upgrade California). This does not include in-kind contributions from the participating cities and the California Air Resources Board.