10 (Electricity)-10 (Gas)-10 (Water) + (Plus) Multi-family Competition and Energy Star Portfolio Manager Benchmarking Pilot Program Design

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ABSTRACT

The 10 (Electricity) – 10 (Gas) – 10 (Water) + (Plus) Multi-family (MF) Competition and Benchmarking Pilot program is an approach to engage multi-family (MF) complexes to reduce electricity and gas usage by 10% and water more than 10% within a 12-month period using experimental design. The pilot will use a randomized encouragement design (RED) in a randomized control trial (RCT) in order to assess intervention strategies to motivate MF complexes to save energy. MF complexes will be randomly assigned to a control group or one of two treatment groups. Treatment groups will receive encouragement (i.e., incentives) to participate. Treatment Group 1 will receive feedback about their energy usage through a Comparative Usage Report, using ES Portfolio Manager as the tool, to engage property owners. Treatment Group 2 will also receive feedback through the same Comparative Usage Report, but will additionally engage in a MF complex-to-complex and MF city-to-city competition, to engage tenants. The MF market barriers are well documented, especially the split incentive barrier between property owners and renters. By engaging the apartment complex as a whole, this program design will be able to engage both property owners and renters to collectively achieve energy efficiency and conservation goals.

1. Introduction

Climate change as well as increases in greenhouse emissions and threats biodiversity represent some of the most important areas that policy makers and social and environmental scientist have been addressing in recent history. Energy efficiency and conservation are important and urgent objectives to address in light of the current climate. Considering that 40% of the total U.S. energy consumption is consumed in residential and commercial buildings (EIA 2013) and electricity production generates the largest share of the greenhouse gas emissions, (32% in 2012; EPA 2012), the discussion around energy efficiency and the search for viable solutions become even more valuable. There is also considerable demand for water conservation, given the recent drought conditions in California. Households constitute an important conservation target, being major contributors to the emission of greenhouse gases and, consequently, global warming (Abrahamse et al. 2005). Therefore, the aim of the current study is to address conservation through changing household consumption patterns in electricity, gas and water by introducing underused behavioral interventions.

Although there is currently a nationwide initiative, California has a long history of leading the country in implementing energy efficiency and Integrated Demand Side Management (IDSM) programs and policies in order to curb energy consumption behavior. However, a limitation of these dominant policy instruments has been that they assume standard (neoclassical) economic approaches, where agents are perfectly rational, stable in preferences, and time consistent. Additionally, price signals have been used as a main policy instrument to influence consumption behavior, ignoring the decision anomalies, biases and consumer preferences.

Recent studies in psychology and behavioral economics provide a vast amount of evidence refuting the assumptions of the standard economic models that individuals are rational, with stable self-interested preferences. Instead, recent research has shown that individuals have limited attention and are influenced by the social and physical environment. In terms of energy efficiency, this literature suggests that consumers are not motivated solely by monetary incentives and that this problem cannot be addressed by only using price instruments. Literatures in behavioral economics also contradict standard economic models, showing that individuals do not always choose what is best for them in the long run. That is, people often exhibit lack of self-control, and display bias or use heuristics in their decision-making. Realizing these limitations in the consumer decision-making process, non-pecuniary interventions and strategies have been applied in a variety of contexts, including alcohol, cigarette and drug use, donating to charity, exercise, gambling, addiction, financial savings, environmental awareness, and energy savings (Allcott, 2011; Ashraf, Karlan, and Yin 2006; Ariely, Bracha, and Meier 2009; Ayres, Raseman, and Shih 2009; Becker and Murphy 1993; Benabou and Tirole 2003; Bryan, Karlan, and Nelson 2010; Camerer et al. 2003; Charness and Gneezy 2008; Goldstein, Cialdini, and Griskevicius 2008; Fehr and Fischbacher, 2002; Kahneman, Knetsch, and Thaler 1991; List, 2005). Although these interventions have been shown to be effective in a variety of domains, adoption of such interventions and strategies by the energy and water utilities have been relatively slow. This is particularly true in water utilities, where potentials for savings are much higher as only a few behavioral interventions have been implemented to extract further savings.

The California Public Utilities Commission (CPUC) has mandated that all statewide Investor-Owned Utilities (IOUs) reach five percent of all residential customers implement a behavior-based program by the end of 2014. For Southern California Edison (SCE), this requirement translates to 215,000 residential customers. In 2015, SCE will provide continued behavior-based program engagement to 5 percent of all residential customer households. Additionally, given that California is in a state of emergency for water conservation, the current pilot sets a goal of 25% water usage reduction. In D.12-11-015, the CPUC encouraged,

> "the utilities to work with OPOWER, EHC, and other interested parties to initiate a process for expansion of the definition of behavioral programs as well as initiating additional program activities in this cycle. Nothing prohibits the utilities from going beyond this minimum level and definition. If there is consensus on additional types of activities in the behavioral area that would be beneficial, the utilities may initiate them as soon as possible utilizing the program and administrative flexibility they have already been granted and/or they may seek specific authority from the Commission, if necessary."[1]

[1] Decision (D.) 12-11-015, PP. 76-77

Two guiding documents have been developed to provide additional details and guidelines for behavior change programs – "Paving the Way for a Richer Mix of Residential Behavior Programs" and a "Behavior Straw-Proposal", that offer a new, not formally approved definition of behavior-based programs developed by the California IOUs and CPUC Energy Division staff. These documents direct California IOUs to focus on one or more underused behavior change intervention strategies in their program designs, including social norms, social preferences and cooperation, framing, loss-aversion, incentives, commitment, feedback and competition.

In order to meet the CPUC's requirements and implement behavior-based approaches detailed in the documents mentioned above, this pilot program will use a multi-pronged behavior strategy to engage residential customers (i.e., property owners and tenants) in multi-family (MF) complexes to decrease energy usage by utilizing social competition (group) and feedback strategies. In the proposed study, MF complexes in one city will compete against MF complexes in different cities in order to achieve ten percent savings in electricity, water and gas separately. The idea behind this underused (in the energy field) behavioral intervention is that constructing teams will motivate individuals to participate, leading to the success of the group. This design is supported by behavioral economics literature indicating that, contrary to the classical rational agent assumption, it is not possible to understand the effects of competition if concepts of fairness, reciprocity and cooperation are neglected (Fehr and Fischbacher 2002; Lindbeck and Snower 1998; Pentland 2014). In line with this notion, the objective of the pilot program is that creating a competitive environment creates teamwork and cooperation among the team members, so success of the MF complexes will depend on the individual success as well. "Coordination and cooperation among peers are powerful shaping forces – our friends watch our backs, in sports and business teammates cooperate to win against other teams, and everywhere people support family, children, and the elderly (Pentland 2014)." However, cooperation among larger groups may be limited because individual self-interest may conflict with the best interests of the group (tragedy of the commons) or individuals consume more than their share of a resource. These problems may be especially relevant when individuals are not monitoring each other and there is no individual punishment. This study attempts to overcome (or at least reduce the effect of) these limitations by setting a clear goal, establishing group commitments and creating a strong social environment where people are motivated to compete in a within MF complex competition, a MF-to-MF competition, or a city-to-city competition.

Traditional programs motivating changes in consumption behavior have mainly focused on educational information and financial incentives only. The assumption underlying these programs is that once people receive information and financial incentives, this would motivate behavioral change. However, by assuming that educational information or financial incentives only is enough to elicit behavioral change, these earlier approaches have ignored the difference between perceived value of the information and the actual value of the information. The proposed pilot study is intended to reduce the gap between the perceived and actual valuation of the information by emphasizing the strong social preferences and ties in a competitive environment in addition to the individual financial gains. Bond et al. (2012) demonstrates the importance of social for behavioral change using Facebook users. Specifically, they showed that users that received a social message from their social ties were more likely to change their behavior than people who received generic information. This suggests that social ties are important in eliciting behavioral change, and add support to our study design utilizing social norms to change energy behavior. The current study also utilizes social ties, but in a context where savings will be induced by employing group-to-group competition. The study actually

frames the message of savings, which provides both financial gain and positive environmental externality, in a competition setting.

2. Theoretical Background and Literature Review

Recent increases in non-monetary interventions using behavioral economics and psychology have been shown to be effective in motivating consumers to conserve energy. In a variety of areas, many behavioral concepts have been implemented to "nudge" consumers toward behavioral change to increase health, wealth, and other benefits. There are some studies that have reviewed/tested concepts or designs similar to what is being proposed by SCE, although in different settings. However, few of these studies are larger than SCE's proposed pilot design. These studies indicate that there are further opportunities to implement various behavioral concepts within different settings to better identify what drives consumers' energy use behavior. The goal of SCE's pilot program is to enable evidence-based and data-driven decision-making by applying some of the behavioral concepts and tools suggested in this study.

Studies have shown that customers are more likely to make permanent changes in their energy behaviors if the new behaviors are easy and convenient to perform, skills and resources are available, peer pressure and social norm dictate the change, and when commitments to change are made in public settings (Costanza et al. 1986; Stern 1992; McMakin, Malone, and Lundgren 2002). As suggested by McMakin, Malone, and Lundgren (2002) and other recent studies, people are more likely to adopt energy-efficiency behaviors under certain conditions. For example, people are more likely to initiate behavioral change when they view these changes as personally benefitting themselves. In terms of energy efficiency, this means that people are more likely to conserve energy when it involves increasing their own comfort and well-being versus simply saving energy for environmental purposes (Becker et al.1981). Another factor that is important in behavior change is visibility. That is, when people can see their energy use and savings, they are more motivated to form goals to change their usage behavior (Kempton et al., 1992; Harding and Hsiaw 2014). This visibility is especially effective when this information is made personally salient (Tversky and Kahneman 1981; Costanza et al. 1986; Stern and Aronson 1984; Stern 1992; Chetty, Looney, and Kroft 2007; Finkelstein 2009).

Finally, people are likely to change their behavior when social pressure and norms dictate a change. Research shows that people are more likely to identify with more similar others (i.e., neighbors) than less similar others (i.e., people in the same country) and that these in-group ties tend to foster trust between group members and exert social pressure to conform to group norms (Pentland 2014). This indicates that energy efficiency behavior change is most effective when people are reminded of their social ties and people perceive that others in their group are making changes to conserve energy.

However, it is not simply pressure to conform to social norms that motivates people to change their behavior; it is the additional aspect of social comparison that seems to be most effective. For example, Mani, Rahwan, and Pentland (2013) showed that social pressure is an effective tool to encourage homeowners to conserve electricity. In their study, homeowners were given social feedback on how much electricity they were using compared to the average person in their neighborhood, or the average person in their country. Results showed that when people were compared to their neighbors (vs. people in their country), they were more likely to conserve electricity. These results suggest that comparison group matters for energy conservation. Ferraro, Miranda, and Price (2011; Ferraro and Price 2013) support this notion and show that social

comparison may be a more effective component than simply social norms in reducing energy usage, specifically, water usage. In their experiment, participants were randomly given either an information-only message about conservation, a weak social norm condition (i.e., an appeal to conserve the county's resources), or a strong social norm condition (i.e., a comparison to neighbors). Results showed that participants in both social norm conditions showed an increase in conservation (vs. the information-only condition), however, participants in the strong social norm condition that were compared to their neighbors showed a greater increase in conservation than the participants in the weak social norm condition that were only given an appeal to conserve. Further, only participants in the strong social norm condition persisted in their energy saving behavior two years following the experiment. These findings highlight the importance of norm-based behavior change strategies for saving energy and exemplify the effectiveness of social comparison as a means of promoting prosocial behavior, particularly in achieving long-term effects. Taken together, research supports our pilot study objectives, suggesting that energy conservation behavior change is likely when consumers are given feedback comparing their energy usage to that of their neighbors.

In addition to aforementioned strategies encouraging behavior change, the addition of competitive incentives has been shown to be effective in motivating people to put forth more effort in changing their behavior (Apesteguia and Palacios-Huerta 2010; Bracha and Fershtman 2012; Hutton and McNeill, 1981). For example, McClelland and Cook (1980) engaged four areas of a university-affiliated apartment complex in a series of six competitions to conserve energy. A separate, but comparable apartment complex served as a control (no competition). Results showed that the apartment complex that was engaged in competition saved more energy than the control complex, indicating that incentivizing energy conservation through competitive incentives is an effective strategy for behavior change. Competitive incentives have also been shown to enhance the effectiveness of other energy conservation strategies when used in combination with such strategies (e.g., participants in college dormitories conserved more energy when given real-time feedback vs. aggregated feedback in an inter-dormitory competition; Peterson et al. 2007; see also Bekker et al. 2010). This research adds support to the current pilot study design and highlights another important contribution of the pilot study – to our knowledge, this is the first study to employ a competitive incentive design using non-university-affiliated multi-family apartment complexes and assess both individual and master meters to measure energy usage (vs. solely master meters in university housing) in an experimental context.

Considering the findings from the literature, the pilot design is intended to utilize social ties by emphasizing the competition among the multi-family apartment complexes, creating a 10-10-10 goal and commitment structure. Few, if any, studies have explored the competition among multi-family apartments. The current proposal limits the study by only utilizing apartment associations.

3. Pilot Goals

The 10 (Electricity) – 10 (Gas) – 10 (Water) + (Plus) Multi-family (MF) Behavioral Pilot Program will use a randomized encouragement design (RED) in a randomized control trial (RCT) settings to engage MF complexes to reduce gas and electricity use by 10% and water by more than 10% within a 12-month period.[2] The study design will follow three behavior program

[2] This pilot program design may be expanded to include single-family units in conjunction with a Home Owner Association (HOA) and/or Condo units with an HOA; however, this is not the initial pilot program focus.

best practices: (1) Test different, underused behavior intervention strategies with innovative designs, (2) Ground the pilot in generally accepted social science research and behavior theories, and (3) Yield evaluable effects, especially to support energy savings reporting.

An additional objective of the pilot study is to assess the use of the MF Energy Star Portfolio Manager Software as an effective intervention strategy for encouraging a reduction in energy usage. This software is designed as an energy benchmarking system that is a point of reference for comparing MF complexes' relative performance (i.e., energy use intensity and Energy Star score) to other similar complexes. This metric tool includes both energy and water consumption and allows tracking of performance over time. Depending on this performance, properties are eligible to receive Energy Star Certification if scores range between 75 and100. These scores range between 1 (not at all energy efficient) and 100 (very energy efficient). In order to provide benchmarking information in the Portfolio Manager, property information such as property type data and energy consumption data need to be provided by the MF complexes. In order to receive an Energy Star score, Portfolio Manager accesses energy meters that account for all energy use for all fuel types in the entire building, regardless of who receives or pays the utility bills. There must be at least 12 full consecutive calendar months of energy data for all active meters and all fuel types need to be available. This metric normalizes building variables (and takes into account additional variables such as weather than may influence energy consumption) and thus, allows MF complexes to be compared to each other.[3] [4]

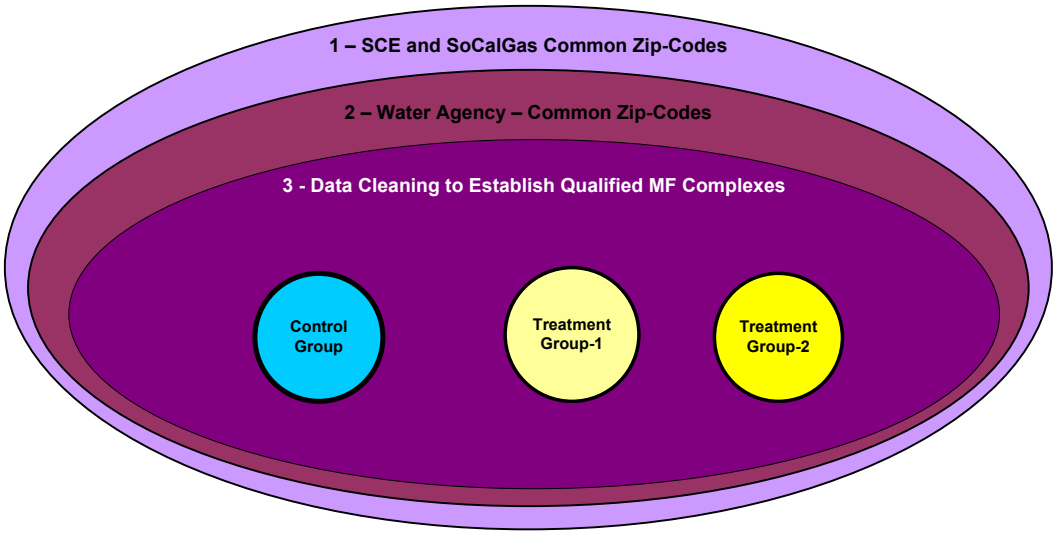
3.1 Pilot Sample Qualifications

For MF apartment complexes to qualify for the pilot, the following criteria must be met:

- Only apartment complexes with 20 units or more will be eligible, in order to adhere to Rule-15 and the limitation within Energy Star Portfolio Manager (i.e., to have an Energy Star score, the MF complex must have 20 or more units).
- SCE would like to engage a mixture of master-metered as well as individually metered apartment complexes for electricity use.
- Master-metered apartment complexes are typically the norm for gas and water, however, if individually metered properties exist, they will be included in the pilot.
- Ideally, the participating complexes will be a mixture of low-income, affordable, and market rate apartment complexes.
- The participating MF complexes will be customers of SCE/SoCalGas and have a common water agency, if possible. To qualify for the pilot, the MF complex must support two out of three resources from the pilot sponsors (i.e., electricity and gas). Please refer to ***Illustration-1*** for more details.

Illustration-1: Data Cleaning Approach to Establish a Qualified MF Complex Population

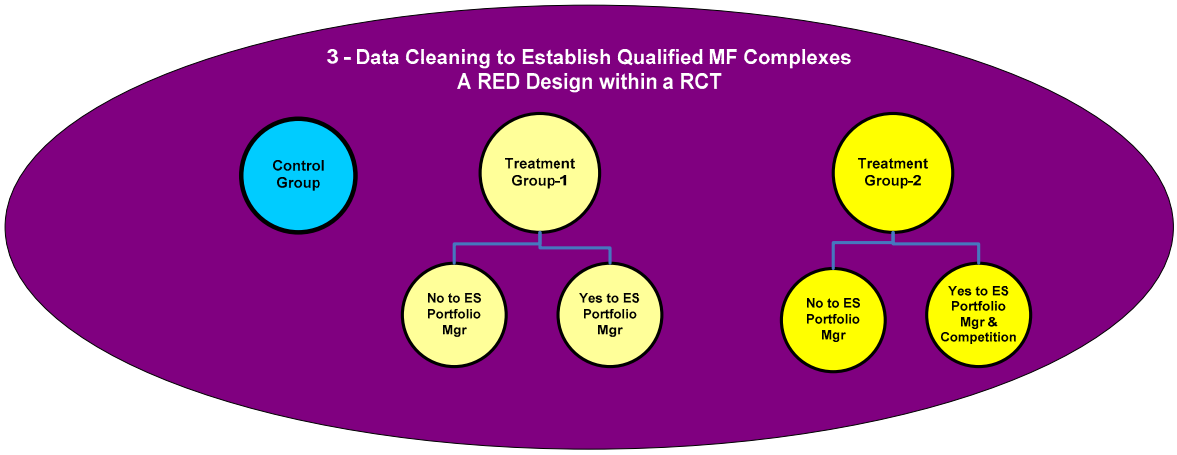
[3] www.sce.com
[4] http://www.energystar.gov/buildings/index.cfm "Benchmark with EPA's ENERGY STAR Portfolio Manager"



3.2 Pilot Design

This pilot will use a randomized encouragement design (RED) in a randomized control trial in order to determine whether the use of the MF Portfolio Manager is an effective tool to encourage MF complexes to save energy (Treatment Group 1) and if engaging MF complexes in competition results in additional savings above and beyond the use of MF Portfolio Manager alone (Treatment Group 2).

Illustration-2: A RED Design within a RCT



As indicated in ***Illustration-2*** above, MF buildings will be randomly assigned to a control group or one of two treatment groups. The treatment groups will receive encouragement to participate in the pilot (the control group will not be given encouragement, but will be eligible if they elect to participate). The MF complexes in the control group will be assessed "as is" and will serve as a baseline for comparison to the treatment groups. Treatment Group 1, targeting property owners, will receive an invitation to participate in the MF Portfolio Manager via a

Comparative Usage Report using the Portfolio Manager as the software tool to generate the comparative usage information as feedback. Treatment Group 2 will also be invited to receive the same Comparative Usage Report, and like the first treatment group, plus additional on-site marketing, competition and reward/s treatments (see details at Table-1, below), targeting tenants.

Table-1: Types of Treatment & Treatment Groups

	Treatment-A: Invitation to Benchmarking & Sign-On Incentive	Treatment-B: Plus, On-site Marketing Support, Competition & Reward/s
Targets	Property Owners	Property Owners & Tenants
Control Group	---	---
Treatment Group-1	Comparative Usage Report	---
Treatment Group-2	Comparative Usage Report, plus	On-Site Marketing Support, Competition & Reward

Note – Treatment Group-2 will receive Treatment-A and Treatment-B at the same time.

The Treatment Group 2 will receive materials for on-site marketing in order to engage residents of the individual apartment units within the MF complex in competition at two or more levels. The first level will be a MF complex-wide competition. Energy consumption will be self-measured on a month-to-month basis and compared to energy usage in the same month in the prior year, using outputs from the ES Portfolio Manager.[5] The next level of competition will be a MF complex-to-MF complex competition). Each apartment complex in the competition can choose an avatar to represent their complex and compete against another MF complex represented by a different avatar. For example, the "Ring of Fire" MF complex can compete against the "Batman" MF complex in the same city or within a different city in the same territory. On a bi-monthly schedule, the participating MF complexes will receive a Comparative Usage Report, using outputs from ES Portfolio Manager, such as ES Score and EUI (i.e., Energy Usage Intensity). The ES Score and EUI will also form the basis for group-to-group and city-to-city competition. There are interim awards to engage the tenants and to generate excitement. The final reward will be based on cumulative results but will be designed to show recognition of accomplishments at the MF complex level, including both property owners and tenants. See, ***Table-2*** for illustration implementation cadence.

Table-2: MF Competitive Report & Competition & Reward

Time	Mailings to Property Owners	On-site Marketing Support & Tenant Engagement with Competition	Reward/s
Month-1	Mailing-1	On-site Signage Treatment-1	#1 - Announce reward options
Month-2	N/A	N/A	N/A

[5] This metric will need to be normalized to at the per unit level.

Month-3	Mailing-2	On-site Signage Treatment-2	#2 - Announce interim winner/s & provide reward/s
Month-4	N/A	N/A	N/A
Month-5	Mailing-3	On-site Signage Treatment-3	#3 - Announce interim winner/s & provide reward/s
Month-6	N/A	N/A	N/A
Month-7	Mailing-4	On-site Signage Treatment-4	#4 - Announce interim winner/s & provide reward/s
Month-8	N/A	N/A	N/A
Month-9	Mailing-5	On-site Signage Treatment-5	#5 - Announce interim winner/s & provide reward/s
Month-9	N/A	N/A	N/A
Month-10	Mailing-6	On-site Signage Treatment-6	#6 - Announce interim winner/s & provide reward/s
Month-11	N/A	N/A	N/A
Month-12	Mailing-7	Final On-site Signage Treatment-7	#7 - Announce final winner/s & provide reward/s

As indicated in the ***Table-3*** below, the pilot is using ES Portfolio Manager as a tool to generate outputs such as ES Score and Energy Usage Intensity values to form the basis of competition and reward. By grouping participating MF complexes into logical groups, a city-to-city partition can be easily formed. For the pilot program in Southern California, a city-to-city partition using water agencies may be a good option.

Table-3: MF Multi-Level Competition

MF Complex Self-Competition	MF Complex-to-Complex Competition	MF Complex City-to-City Competition
Trending of ES Score and Energy Usage Intensity value for a single MF complex over time	Trending of average/median ES Scores and Energy Usage Intensity values for two MF Complexes over time	Trending of average/median ES Scores and Energy Usage Intensity values for logical groupings of MF complexes over time

A 10% behavior-only (i.e., without plug load appliance upgrades) reduction in electricity usage may be difficult to achieve, however, a 10% reduction in water usage should be easily achievable (EPA 2015; Mitchell and Chesnutt 2013). Based on studies-to-date for Opower based Home Energy Reports, behavior-only electricity and gas energy savings can be as low as 1.0% depending on the customer's targeting strategy. However, Mani, Rahwan, and Pentland (2013) showed that social network incentive caused electricity consumption drop by 17%, much higher

than previous energy conservation campaigns and studies. In contrast with the earlier studies, the study managed to design an experimental setting where consumers could relate to the people in the comparison group. Such a design is expected to increase both trust and the social pressure among the consumers, which eventually reflected in consumers' energy consumption behavior in the study. This is also aim of this study.

It should be also noted that this pilot aims to measure the durability of the intervention, especially once intervention stops after one year. Most recent studies on treatment persistence suggest that the effectiveness of non-pecuniary strategies decay over time (Ferraro and Price 2013; Allcott and Rogers 2014). However, in contrast to the previous studies, we intend to create an environment encouraging close social ties, and thus, the rate of decay is likely to be lower than prior studies once we remove the avatars. This persistence of treatment also has an impact on assessing the cost effectiveness of utility behavioral programs as it is often the case that any behavioral and non-pecuniary programs are evaluated by the energy savings of the same year. However, this method of assessment ignores the possibility that reports delivered during a given year can result in additional conservation in future years (Allcott and Rogers 2014).

Conclusions and Potential Implications

The current pilot draws methodology from behavioral economics and psychology, employing behavioral interventions that focus on feedback/benchmarking and competitive incentives to engage MF complexes to reduce usage of electricity, gas, and water.
This pilot is important beyond simply proposing a method of behavioral change; it also makes important methodological contributions to the field of energy efficiency. That is, unlike prior studies (see Jones & Vine, 2015), this pilot uses an experimental design to randomly assign MF complexes to each condition, allowing inferences to be drawn about the effectiveness of particular interventions for the MF population. Another unique aspect of the current pilot is the participant sample. Prior research using competitive incentives to encourage energy conservation have engaged students residing in university-affiliated apartment complexes, something that may limit the generalizability of the results. University students may be a unique subpopulation given that students may be more likely to participate in a program simply because it takes place in a university setting, they may have different energy use patterns than the general population (e.g., time spent at apartment, number of people residing in apartment, etc.), and may not value energy conservation if they are not paying for utilities (university residence hall or utilities included housing). This pilot program is the first to engage non-university-affiliated MF complexes (see Bekker et al. 2010; McClelland and Cook, 1980; Peterson et al. 2007) and assess energy usage through both individual and master meters. This is also the first study to do this on a large scale.

Results of this multi-family pilot program and subsequent studies will have broader implications for California policy makers. Finally, this pilot is unique in its innovative usage of the Energy Star Portfolio Manager software, as a tool, to test the implications of the aforementioned underused behavioral interventions, to engage both property owners and tenants. The results of this study are also expected to encourage utilities and the government to motivate residential multi-family complexes to participate in benchmarking activities.

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