10-10-10+ Multi-Family Behavioral Pilot Program: Final Analysis

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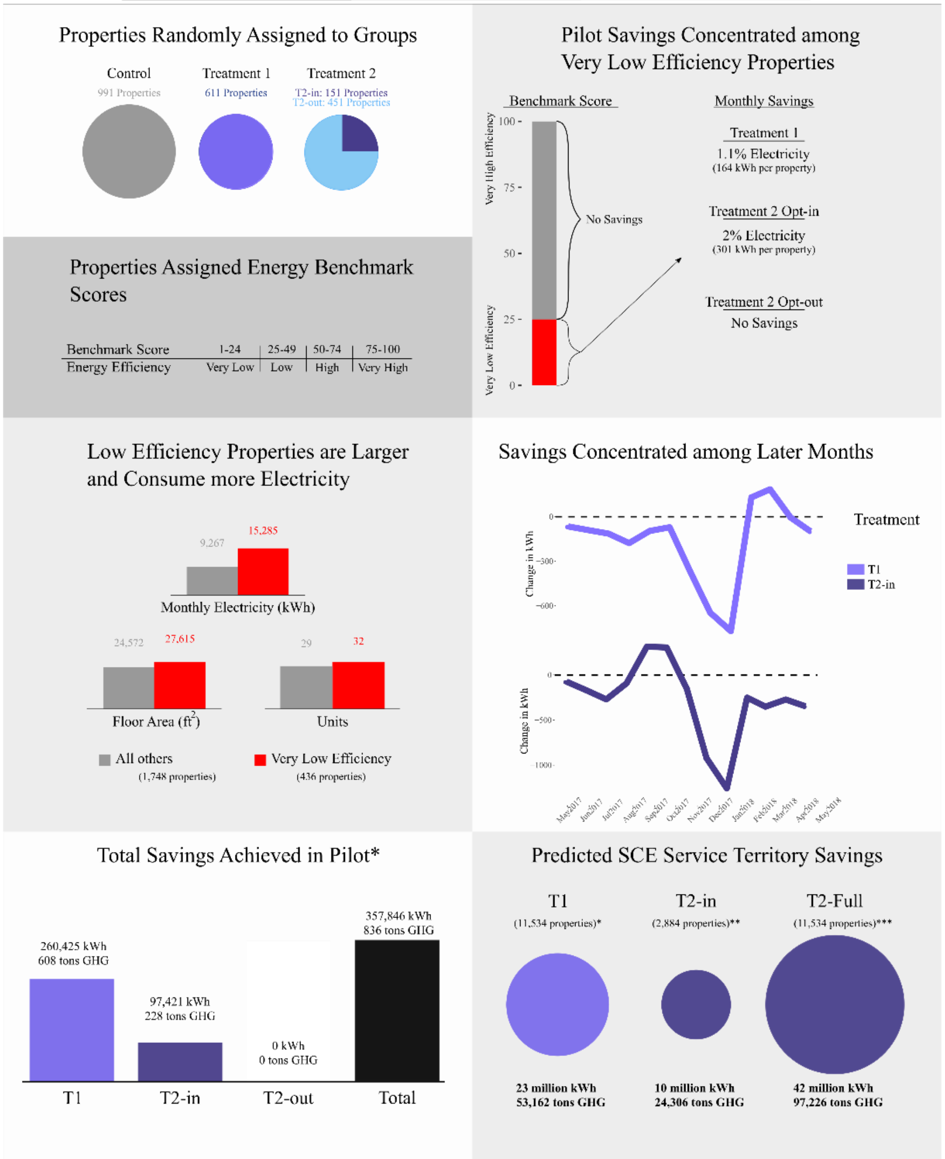
Graphic Summary

Goal of the Pilot: Use behavior intervention strategies to encourage multifamily complexes to reduce electricity usage by 10%, gas consumption by 10% and water by 10%, or more.

10-10-10+ Multi-Family Behavioral Pilot Program

Program Summary: Over 2,000 Multifamily Residential properties were recruited in 2016 to participate in a 1-year energy efficiency competition. Properties were assigned to two treatment groups (T1 and T2) and a control group. The T1 Group received competition reports, mailed directly to property managers while the T2 Group received mailed, online and on-site competition marketing directed to tenants in addition to competition reports.

Groups:	Comparative Usage Reports mailed to property managers.	On-site competition marketing directed to tenants.
Treatment 1 (T1)	Yes	No
Treatment 2 Opt-In (T2-in)	Yes	Yes
Treatment 2 Opt-Out (T2-out)	Yes	No
Control	No	No



*Savings aggregate monthly estimates over 12 month period for over the properties with Very Low benchmark scores: 132 for T1 and 27 for T2.
(Example: T1 electricity kWh savings = 164.4 x 12 x 132 = 260 thousand)
The GHG reductions are calculated by first applying the EPA's site-source ratio of 3.14.

*Predictions assume savings from 25 percent of 46,137 SCE MFR properties mapped by Res-Intel.
** T2-in predicts a 25 percent opt-in rate, equal to the rate observed in the pilot.
*** T2-Full assumes full opt-in for T2 and is highly optimistic. It represents the upper-bound of the program effect.

Executive Summary

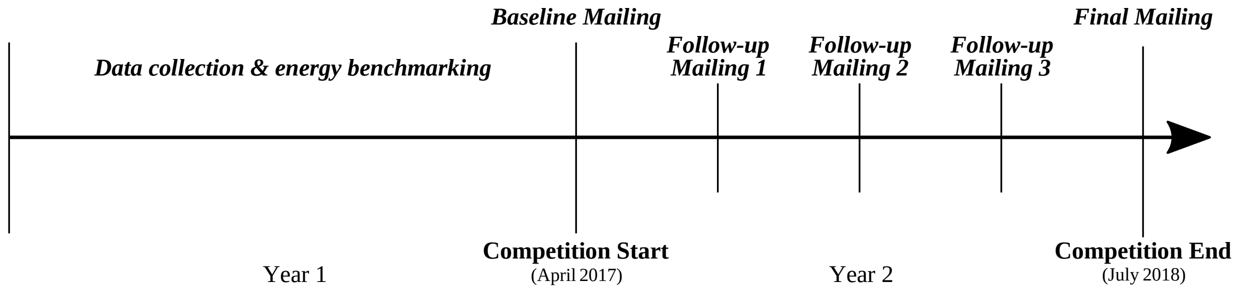
The 10-10-10+ Multi-Family Behavioral Pilot Program, also referred to as "Communities for Conservation" (CfC), was designed to bring about 10 percent reductions in electricity, gas and water[1]consumption over a 12-month period, targeting multifamily residential (MFR) properties. These reductions were to be achieved through a set of behavioral strategies (competition, feedback, commitment, follow-through and rewards); CfC participants were entered into a competition that rewarded MFR buildings which achieved top ratings in energy efficiency and energy reductions over a 12-month period. The Pilot used a Randomized Control Trial (RCT) and a Randomized Encouragement Design (RED) designed to evaluate the CfC pilot and determine the effectiveness of behavioral treatments aimed at motivating energy conservation. This report summarizes the results of a Randomized Controlled Trial (RCT) implemented from April 2017 to July 2018.

The pilot applied two treatments to encourage competition and energy reductions:

Groups	Treatment(s) Received		# of Complexes
Treatment Group 1 (T1)	Treatment A	Quarterly comparative usage reports mailed to property managers, describing the energy scores of each multifamily complex, tips to reduce consumption of electricity, gas and water as well as the terms of the competition.	611
Treatment Group 2 Opt In (T2-in)	Treatment A + B	Treatment A plus on-site marketing banners, tips, door hangers, mailers and a website designed to engage tenants in reducing their consumption of electricity, gas and water.	151
Treatment Group 2 Opt out (T2-out)	Treatment A	Same as above.	451
Control Group	None		991

[1] The proposal called for water reductions greater than 10 percent, which explains the "+" in the program title.

Figure I: Program Timeline



The pilot competition and mailing period had originally been scheduled to take place over a 12-month period. However, various factors affecting implementation led to deviations from the planned timeline, so the competition and mailing period fact spanned 15 months, from April 2017 to July 2018.

Results

The pilot produced statistically significant savings in electricity consumption in only a few cases. Regressions estimated on various subsets of properties reveal that the magnitude of these savings varied substantially depending on property attributes. Some findings suggest that the competition marketing and comparative usage reports had a significantly greater impact on the most inefficient properties which were assigned low benchmark scores at the start of the competition. These findings will be described throughout this report.

MFR Benchmark scores were determined using the energy use intensity (EUI) measurement, which normalizes energy consumption by building size, and further adjusts for weather and property attributes. Future competitions or MFR programs of a similar nature would therefore be well-advised to target low-efficiency properties, identified using an identical or similar benchmarking method.

The T1 group was designed to measure the effects of competitive participation when comparative usage reports are mailed to property managers. A total of 611 properties were assigned to the T1 group and 991 to the control group. The T2 group contains a total of 602 properties. The T2-in group had 151 properties who opted-in to receive on-site marketing and were recruited through a combination of emails, phone calls and in-person visits.[2] While T2-out (count of 451) are properties that chose not to receive on-site marketing and were only sent the comparative usage reports.

The number of properties assigned to each group was decided based on a power analysis summarized in the *10-10-10 Sample Design Documentation* Memo (October 18, 2016) and exceeded the quantities proposed in the original advice letter.[3]

[2] Emails and in-person recruitment had success rates of 4 percent and 35 percent.

[3] In total, 2,354 properties were recruited to the pilot, although this report summarizes results only for the 2,204 of which there was available energy consumption data.

Figure II

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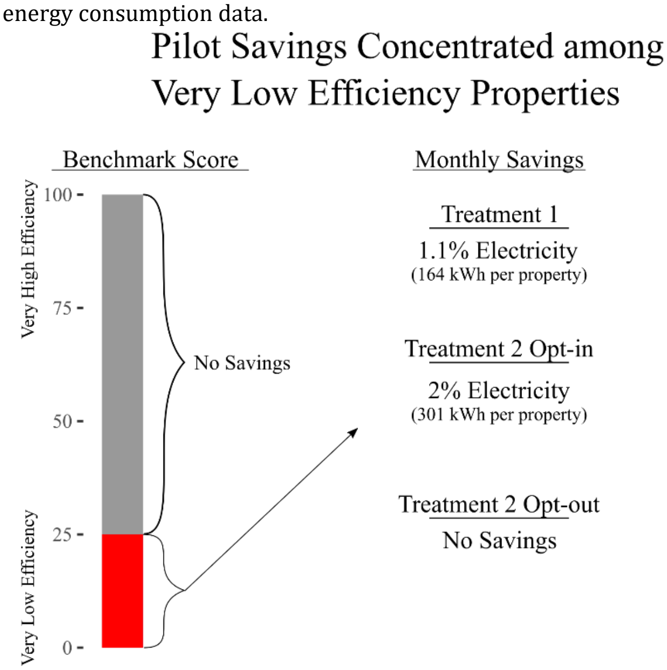


Treatment Group 1

Savings were concentrated among the most inefficient properties participating in the pilot. Regression estimates show that 132 of these inefficient properties averaged 164 kWh in savings per month. These properties averaged 12×164.4 = 1,973 kWh savings during the year following treatment. In total T1 produced 132×1,973 ≈ 260 thousand kWh in savings over the course of a year.

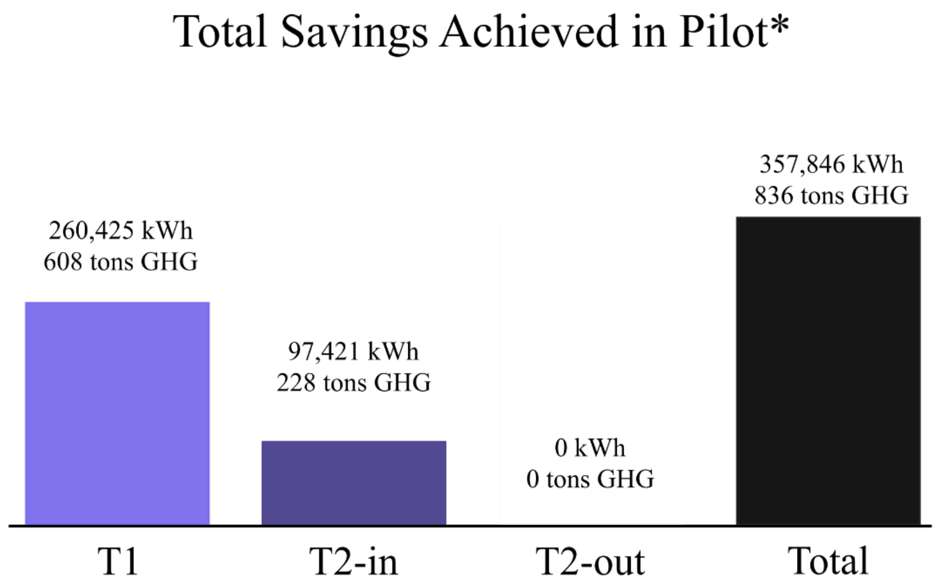
We project that T1 could save up to 22 million kWh over the course of a year if the program were expanded to include all MFRs in the SCE service territory. This calculation reflects projected participation of 46,137 MFR properties, 25 percent of which fall into the subset of inefficient properties that were induced to save energy.

Treatment Group 2

Inefficient properties that opted-in to the on-site marketing (T2-in) saved 301 kWh per month in the year following the treatment. However, those that opted-out of marketing (T2-out) did not produce any savings. The implications of this finding are not entirely certain because both the T2-in and T2-out groups are self-selected samples of participants. Nevertheless, the findings are consistent with an increase in savings due to on-site marketing. The 27 low-efficiency T2-in properties produced 27×12×301 ≈ 97 thousand kWh in the year following the treatment.

We project that the T2-in design would save up to 10 million in kWh in one year if expanded to the entire service territory and assuming an identical opt-in rate of about 25 percent. If, however, the opt-in rate was increased to 100 percent, these savings may reach as high as 42 million kWh in one year.

Figure III



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(Example: T1 electricity kWh savings = 164.4 x 12 x 132 = 260 thousand)
The GHG reductions are calculated by first applying the EPA's site-source ratio of 3.14.

Heterogeneity

The Res-Intel regression analysis also compares electricity savings achieved by buildings of various sizes. T1 offered little evidence that building size affects savings. However, we find that smaller T2-in group properties, with fewer units, produced the greatest savings. Greater effectiveness of on-site competition marketing among smaller MFR buildings may arise because the targeted marketing is more effective when total building consumption depends on the efforts of fewer residents. This observation is consistent with the theory of moral hazard, or the tragedy of the commons, which says that individuals exert diminished effort towards a group goal as the size of the group grows larger.

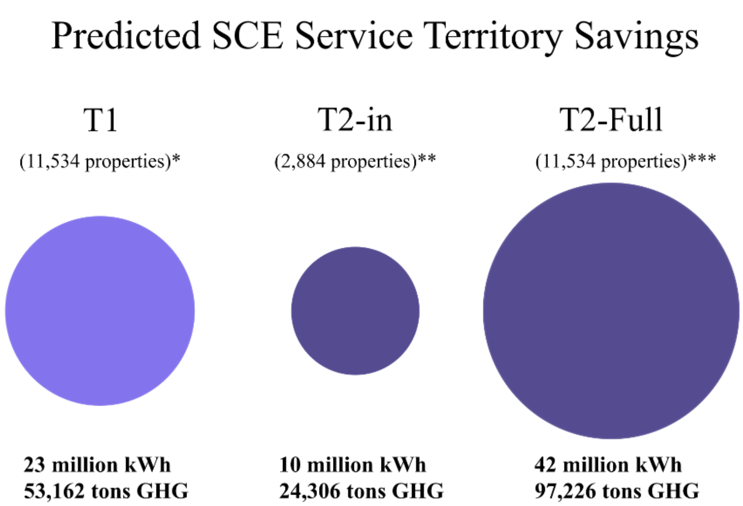
Our savings estimates and projections from the pilot are derived solely from changes in consumption among the most inefficient properties participating in the pilot. We found that properties with benchmark scores in the bottom quartile contributed an average of 1,973 kWh in savings among the T1 group and 3,608 kWh among the T2-in properties. These savings aggregated to a total of 260,424 kWh for T1 and 97,421 kWh for T2-in; and we project savings of 23 million kWh (T1) and 10 million kWh (T2-in) if the treatments are implemented across the entire mapped service territory.

Table I: Monthly Electricity Savings (kWh) per Property, by Building Attributes

Attribute	Range	Properties		Savings (kWh)	
		T1	T2-in	T1	T2-in
Benchmark Score	1 - 24	132	27	164	300
	25 - 49	153	47	-9	84
	50 - 74	166	42	16	-6
	75 - 100	160	35	-35	66
Number of Units	15 - 17	119	18	8	-10
	18 - 23	170	43	-49	98
	24 - 35	161	39	13	100
	36 - 100	161	51	128	49

Highlighted terms are highly statistically significant.

Figure IV



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Gas & Water

The calculation of Gas savings will be referred to a separate study.

Savings for water in this summary are inconclusive. There are two possible reasons for this:

1. The regression analysis did not find statistically significant reductions in water consumption based on the limited validity of the data collected.

2. The water consumption data exhibit inconsistencies that were not fully vetted, potentially minimizing the statistical results for estimated gas and water savings (see Appendix A).

Although this report does not provide a full analysis for water, it does present an exploratory analysis of changes in water usage in Section 4.3. The exploratory characterizes the reductions in water consumption among treated properties and identifies common attributes among high and low reducers.

Recommendations

Based on our findings Res-Intel offers the following comments and recommendations:

1. The results show that the bulk of the energy savings from the pilot accrue to customers with very low benchmark scores (very low efficiency). In our sample, this included properties with a monthly EUI of 1.4 or greater (defined as kBtu per square foot). Future behavioral MFR programs should target low efficiency customers in order to cost-effectively save energy. However, in order to target this group, each utility will need to perform MFR benchmarking for some or all of their service territory. This is consistent with the trend in the state to benchmark MFR properties.

2. The lack of substantive water savings is likely due to the small number of participating water properties. Only 159 MFRs with water data were included in the pilot, and they were split between the control and two treatment groups. Two of the water agencies' customer data provided for the CfC pilot included very few MFR properties, but thousands of single family and condominium customers' data. This indicates that water utilities don't have adequate data integration to effectively target customers based on their property type and resource usage needs. Another reason for the lack of strong results was the influence of California's drought on customer behavior. Governor Brown declared an end to California's drought on April 17th, 2017. This was right as the competition started, and after the baseline period had ended.

3. Billing data quality is a fundamental requirement when assessing program impacts. Our analysis has identified important data quality features such as well-defined billing cycles and month-to-month consistency in reported consumption (see Appendix A).

4. The lag in treatment effects, highlighted in the infographic, means that longer duration competitions would likely result in larger savings. The delay in the initiation of savings at apartment complexes is to be expected as property managers are typically very busy. It is also consistent with the lead-time required to install energy efficiency measures. Each additional mailer served as a reminder to take action, whether behavioral or through installing more efficient equipment

1 Pilot Introduction & Overview

The 10-10-10+ Multi-Family Behavioral Pilot Program, also referred to as "Communities for Conservation" (CfC), was designed to bring about 10 percent reductions in electricity, gas and water consumption over a 12-month period, for multifamily residential (MFR) properties. These reductions were to be realized by testing a multitude of behavioral strategies including:

- Competition – MFR properties competed based on MFR complex-to-MF complex competition;
- Feedback/Benchmarking – Comparative usage reports and additional information were provided to the participating MFR properties on a quarterly basis;
- Commitment – The pilot focused on seeking a 10% reduction in electricity, gas, and more than 10% in water usage, from the MFR properties baselines;
- Follow-through – The pilot provided energy efficiency tips to the apartment renters and property owners/managers to drive behavior change to support 10 percent reductions.
- Rewards – MFR properties with the largest amount of reductions were eligible to receive $2,500 awards.

This report summarizes the results of a randomized controlled trial designed to evaluate the Communities for Conservation pilot program and determine how effective these strategies are at producing energy savings. It addresses two reporting requirements stipulated in the CPUC Advice Letter ADVICE 3157-E-A:

1. Conduct an early M&V ex-post evaluation, to the extent possible to assess energy savings, verification and validation.

2. Go beyond early M&V to establish pilot impact, conduct a usage analysis to gather energy and resource insights for property owners/managers and tenants' usage behavior.

The Communities for Conservation pilot followed a simple two-year timeline, illustrated on Figure 1.1. In the first year the pilot implementers began collecting metered electricity, gas and water data from a selected group of MFR properties and then used one full year of data to calculate and assign energy benchmark scores to each property. These energy benchmark scores, calculated using Energy Star's Portfolio Manager Methodology, rated the energy efficiency of each property on a 1 to 100 scale, accounting for the property's building attributes and total consumption relative to all other MFR properties in the pilot area.

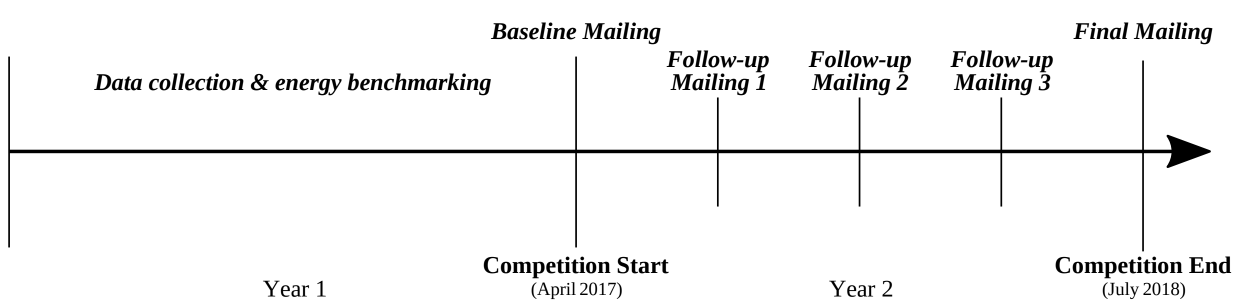
In the second year of the pilot, all participating property managers were mailed a press release describing the Communities for Conservation program, or an opt-In agreement explaining how their participation in the program would allow SCE to post signage and marketing information around the MFR properties to support the programs mission of reducing Gas, Water & Electricity usage by 10%+. The information also informed them that their MFR property is eligible to receive prizes for achieving top performance in one of the three categories.

Top prizes were based on the following categories:

Category	Description	Grand Prize Award
Achieving the greatest absolute energy-use-intensity (EUI) reduction	Reduction in energy per square-foot comparing the start and end of the evaluation period.	A maximum of $2,500 funding for a past energy efficiency improvement or receive free Nest thermostat installation for the entire property.
Achieving the greatest percentage EUI reduction	Percent reduction in energy per square-foot comparing the start and end of the evaluation period.	
Achieving the highest energy benchmark score	Benchmark score, based on the cumulative distribution of EUI among all properties.	

Properties were ranked in these categories relative to all MFR properties included in the study. Achievements were evaluated on a quarterly basis from the start of the competition. Winners of these quarterly assessments were named in each of four subsequent competition mailings Winners received trophy items that owners could display at their facilities. Only winners of the final year-end assessment were eligible for the grand prize. Grand prizes included an option to either receive a maximum of $2,500 funding for a past energy efficiency improvement or receive free Nest thermostat installation for the entire property. Three of the eight final competition winners had won previous quarterly assessments.

Figure 1.1: Program Timeline



The pilot competition and mailing period had originally been scheduled to take place over a 12-month period.

However, various factors affecting implementation led to deviations from the planned timeline, so the competition and mailing period fact spanned 15 months, from April 2017 to July 2018.

In addition to outlining the competition rules and incentives, quarterly mailings included a Comparative Usage Report. The Comparative Usage Report informed recipients of their buildings' energy benchmark scores, a measure of how the energy efficiency of one's residence compares to that of similar residences. Comparative Usage Reports included in quarterly follow-up mailings also report the recipient's quarter-to-quarter change in EUI and energy benchmark score. The purpose of the Comparative Usage Report was to raise property manager awareness of their energy efficiency performance (1) relative to that of other properties and (2) relative to their own past performance. By raising awareness of energy efficiency concerns and facilitating social comparisons, the Comparative Usage Report encourages efforts to reduce excess energy consumption.

The reports were mailed in the months of April, October and December of 2017 and March of 2018. The tenants of T2-in properties received direct mail in June and October-November of 2017. The MFR properties that opted in received property signage in November 2017. Signage included indoor posters, counter cards, outdoor banners, tenant brochures, window clings, lawn signs, outdoor banners and tenant door hangers raising awareness of the Communities for Conservation competition. T2 owners and tenants also had access to a website to review the competition status (CforC.energy).

In summary, the competition targeted increases in energy conservation efforts among both MFR property managers and tenants by (1) offering competition incentives that reward improved efficiency relative to past-performance and comparative performance; and (2) providing useful energy efficiency feedback, enhancing knowledge and salience of energy efficiency at the individual property level. We evaluate the effects of the program by observing changes in energy consumption during the 12 months spanning the date of the initial mailing to the end of the competition.

Figure 1.2: Reports and Marketing Material

A key element in this study was the controlled testing of performance with and without marketing and promotional on-site materials between the T1 and T2 segments and T2 opt-in and opt-out sub segments. Samples of the various types of marketing materials that were used are found below and fall into two categories 1) direct communications (reports, et al) and 2) on-site marketing materials. Additional post-launch materials were prepared and utilized but are not included here.

1. Direct Communications

a. Owner Email

Email

EDISON

SoCalGas

Golden State Water Company

Monte Vista

Communities for Conservation

10%

CAN MAKE A DIFFERENCE

Save Resources. Enjoy Benefits. It All Starts Here.

The **Communities for Conservation** challenge is underway and we're thrilled that you're a part of it. You're joining a pool of over 1,200 competitors who are already taking steps to reduce electricity and natural gas by at least 10% and water by up to 20% over the next 12 months.

Active participants will see how working together transforms the power of one into the Power of Many. Plus, we'll recognize top reducers throughout the year. **At the end of the challenge, overall winners receive a great grand prize — help with funding their property's next energy efficiency improvement project.**

Now, let's get started! Click to visit **communitiesforconservation.com** to see the current leader board front runners; review your Energy Report online; and pick up efficiency tips to put into action right away.

To Login:

1. Select the property owner or manager page

3. Enter your ID, zip, and email address

2. Find your ID *(found on your first quarterly Energy Report)*

CONFIDENTIAL

Your Custom Energy Report for:

4. Click "sign in" and you're ready to go

Thank you for participating in this important efficiency challenge.

The Power of ~~One~~ Many is officially at work!

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This email contains a marketing message from Southern California Edison Please do not reply to this email; this is not a monitored email address.

To opt-out of receiving SCE marketing messages, unsubscribe.Your removal request will be honored within 10 business days.

Programs are funded by California utility customers and administered by Southern California Edison under the auspices of the California Public Utilities Commission Funds are limited and are available on a first-come, first-served basis and may be amended or terminated without prior notice.Terms and conditions apply.

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b.   Postcard


Tips
Check out some ideas on how to step-up your efficiency game:
Switch lightbulbs to LEDs or CFLs and encourage neighbors to do the same
Plug electronics into a smart advanced power strip
Use drapes to control your home temperature; draw them during the summer to keep the heat out
Install a water and energy-saving high-efficiency showerhead
Suggest ceiling fans be installed to reduce A/C costs
Keep the air vents unobstructed
Cook smaller meals in toaster ovens or microwaves
Compare notes with neighbors to motivate each other
Reduce Energy, Potentially Lower Bills—It Starts With the Power of ~~One~~ Many
The Communities for Conservation challenge has arrived in your neighborhood and your apartment complex has pledged to do its part! This program unites Southern California Edison, SoCalGas® and top regional water companies with people just like you, pulling together to save energy. Our goal is to reduce electricity and natural gas use by at least 10% and water by up to 20% in 12 months — and those who help may save money and gain the chance to personally win prizes for sharing ideas, tips, or stories at cforc.energy. Doing your part can also help your complex win a great grand prize!
I set my refrigerator temperature to 38 degrees
I take shorter and cooler showers!
I grill dinner instead of using my appliances (especially during summer)
EDISON
P.O. Box 800
Rosemead, CA 91770
PRESORTED STANDARD U.S. POSTAGE PAID SOUTHERN CALIFORNIA EDISON
JOHN Q SAMPLE
1234 MAIN ST
UNIT B
ANYTOWN, USA 90000
Visit cforc.energy to Share Your Ideas and Discover More Ways To Save!
EDISON
SoCalGas
Golden State Water Company
Monte Vista
Actual utility bills vary based on a number of factors including, but not limited to, customer behavior, rate changes, and addition of plug-in appliances. This program funded by California utility customers and administered by Southern California Edison Company, Southern California Gas Company, City of Pomona Water Department, Monte Vista Water District, and Golden State Water Company, and implemented by SCE under the auspices of the California Public Utilities Commission. Program funds will be allocated on a first-come, first-served basis until such funds are no longer available. This program may be modified or terminated without prior notice. ©2017 Southern California Edison. Trademarks are the properties of their respective owners. All rights reserved.


Communities for Conservation
10%
CAN MAKE A DIFFERENCE
Save Resources. Enjoy Benefits. It All Starts Here.
Compete · Conserve · Save
Welcome to the Communities for Conservation Challenge
It's easy to save energy, natural gas, and water while helping your complex strive toward a grand prize! Plus, you'll win with potentially lower bills and the chance to get prizes for sharing ideas, tips, or stories at cforc.energy.
I wash clothes in the cold water cycle
We use a fan for extra cooling!
I turn off the lights when I leave the room
In the summer, I keep my thermostat at 78 degrees

c. Comparative Usage Report (4 pages)

Communities for Conservation

10% CAN MAKE A DIFFERENCE

Save Resources. Enjoy Benefits. **It All Starts Here.**

CONFIDENTIAL

Your Custom Energy Report

Customer name
Street address
City, ST ZIP

Your ID: T1-10

Your property at:
Street address
City, ST ZIP

The **Communities for Conservation** challenge has passed the midway point and competition is heating up! Thanks to dedicated participants like you and your tenants, this year-long program between Southern California Edison (SCE), SoCalGas®, and regional water companies is making a big impact as we strive to reduce electricity and natural gas by at least 10%, and water by up to 20%.

We know you're eager to see how your property is doing and this third report reveals your progress in percentages as compared to your initial baseline data from earlier this year. Remember, as we inch closer and closer to the program's finale, you'll want your efforts and improvements to keep moving in the right direction—and your tenants' participation is key to making that happen. Just keep inspiring them through your own improvements, share new tips, and remind them that when the power of one transforms into the Power of ~~One~~ Many, anything is possible. Plus, don't forget about the perks of participation:

- Lowering consumption can potentially lead to reduced utility bills for you and your tenants
- Our top overall reducers will be crowned **Grand Prize winners** at the end of the challenge and offered funding for their ENERGY STAR® improvements, valued up to $2,500



Southern California EDISON · SoCalGas · Golden State Water Company · Monte Vista Water District

0001149

Want to Know More?

Some Frequently Asked Questions...and Answers

When Will We Learn Who Wins the Grand Prizes?
Our Grand Prize winners will be notified as soon as the overall 12-month savings calculations are complete and the last reports are finalized. Don't worry, if you're a challenge champion — you'll be the first to know. In the meantime, keep saving and doing your best.

If Our Reduction Scores Aren't High Enough to Win, Should We Continue to Conserve?
By all means, YES! While physical prizes boost the appeal of this challenge, there is so much more to participating. You can potentially lower your bills, enjoy real camaraderie in your community and at your complex, and be a part of a larger effort to strengthen our local resources.

Is This Challenge Really Helping?
Yes, now that we're mid-stride in the competition, we are definitely seeing the meaningful impact conservation makes on our resources. Please, keep up your efforts and be assured that doing your part to save energy, natural gas, and water is making a difference that matters.

When Is the End-Date of the Challenge?
The competition is a 12-month program and will wrap up around the beginning of 2018 — you'll receive mailings notifying you as the date grows nearer. Please remember that just because the challenge comes to a close, doesn't mean your conservation efforts should stop! Together, we are building a better and smarter efficiency strategy that's easy to stick with — and the advantages are overflowing. Lowering usage keeps our resource pools strong now and in the future; and it can potentially help save money on utility bills. Ultimately, making conservation a lifestyle is the best outcome we could achieve.

Where Can My Tenants Learn More About the Program?
If your tenants visit **cforc.energy** and login to the Resident portal, they can find a bounty of efficiency tips and resources to keep them motivated, plus they can see the latest quarter's winners' circle. Also, let them know that when they share their own conservation tips on the website they have a chance to get great prizes too.

The Winners' Circle

The latest three-month round has ended and we're thrilled to recognize our newest winners' circle. The goal for our participants is to decrease electricity and natural gas use by at least 10%, plus water by up to 20%, and these complexes showed their dedication and enthusiasm with impressive reductions.

Thank you for your amazing efforts — all of you are proof that little changes can make a huge impact. Keep saving and you could end up an overall challenge champion at the end of the competition! What would you do with a Grand Prize, valued up to $2,500? Fund a new energy-efficient barbecue grill area for tenants? Install a solar pool heater for your community's swimming pool? The options are endless and could greatly enhance your property. Here are this quarter's top performers:

Largest Absolute EUI Reduction	Most Improved Percentage of EUI Reduction	Highest Energy & Water Benchmark Score
Top Overall Electricity Reducer Complex# T1-563 in Hacienda Heights	**Most Improved Electricity Reducer** Complex# T2-105 in Santa Monica	**Most Efficient Energy Building Score** Complex# T2-342 in Arcadia
Top Overall Natural Gas Reducer Complex# T2-567 in Long Beach	**Most Improved Natural Gas Reducer** Complex# T1-201 in Santa Monica	**Most Efficient Water Building Score** Complex# T2-601 in San Marino
Top Overall Water Reducer Complex# T2-559 in Duarte	**Most Improved Water Reducer** Complex# T2-559 in Duarte	

Visit Us at cforc.energy for More Tips and Information

Efficiency Pointers for You and Your Tenants

When it comes to being a real contender in this competition, teamwork is the name of the game. That means getting your tenants involved and inspired — it can make the difference between mediocre percentages and phenomenal success. To do that, lead by example with adjustments to your complex's routine, equipment upgrades, and enhancements that can improve efficiency. To help pay for some of those improvements, be sure to check for rebates from SCE, SoCalGas, and your water company.

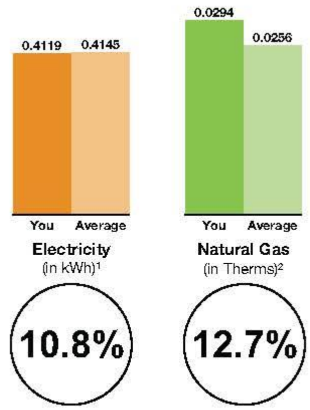
We also want to remind you that despite some improvement in drought conditions, we still urge you to keep conserving water and strive for that 20% reduction goal. Scaling back on water, energy, and natural gas use can result in potentially lower utility costs at your property, boost tenant satisfaction and help strengthen occupancy rates. Review our newest efficiency tips below and share them with tenants — let's keep the **Power of ~~One~~ Many** in motion!

	WATER	ELECTRICITY	NATURAL GAS
Owner Ideas	• Replace washing machines with new energy-efficient models • Convert traditional toilets to low-flow • Add aerators to faucets in units • Sweep walkways instead of hosing them down • Regularly check for leaking or broken sprinklers and fix quickly	• Use motion sensor LED lights outside • As needed, replace furnace filters once a month • Have gas fireplaces tuned up for winter to offer more heat	• Check water heating settings • Change air filters regularly • Install programmable thermostats in units
Tenant Ideas	• Turn off the water when brushing teeth or shaving • Only flush toilet when necessary • Don't pre-rinse your dishes before loading in dishwasher • Take a shower instead of a bath	• Seal window air leaks with caulk or spray-seal • Clean your refrigerator coils to help it run more efficiently • Replace incandescent bulbs with CFL or LED lighting	• Defrost frozen food in the refrigerator to cut down on cooking time • Close doors in unused rooms to conserve heat • Layer blankets while sleeping instead of turning up the heat

Your Efficiency Progress

Your EUI Usage

This section shows your building's average monthly usage per square foot over the latest three-month round and the percentage-change since our baseline reporting. (Please note that your baseline may have been slightly modified due to billing adjustments, credits or corrections). The data reflects your tenants' usage and the usage in your building, plus common areas collectively — specifically, what we call Energy Use Intensity (EUI). We calculate your property's EUI by combining 12 months of your natural gas and electricity usage, converting the result to source energy and dividing that number by your building's square footage. A negative number on your report means you're doing great and showing impressive results — you want to **go for low with EUI!**



Your Building Score

Amazing Job!
You're ahead of the pack.

76
Energy Score

This score is where you can see how your building's efficiency matches up against other randomly assigned properties. We tally this score using factors like your building's EUI, plus weather and building data. The scale ranges from 1 to 100 with higher scores reflecting better efficiency. Is your number closing in on 100? If it is, you're an efficiency star this quarter. If not, keep trying — you can do it! Go for high here!

We make every attempt to ensure the accuracy of the aggregated consumption data. However, utility billing practices may cause variation in the data. Due to certain unusual billing situations (billing period cycles, credits, adjustments, etc.), there is a possibility that actual usage data may vary from aggregated usage data. We assume no liability for any discrepancies between reported data and actual data.

Explore Our Programs and Offers

Keeping up with the latest energy-efficient strategies for your apartment community is key to succeeding in this competition. Check out conservation tips through SCE, SoCalGas, and regional water companies; select effective water- and energy-saving products/devices; and take advantage of valuable incentives.

Southern California Edison	SoCalGas	City of Pomona	Golden State Water Company	Monte Vista Water District
sce.com/multifamily	socalgas.com	ci.pomona.ca.us	gswater.com	mvwd.org

Visit Us at cforc.energy For More Details or Tips on How to Improve Your Scores.

[1]kWh stands for kilowatt per hour and is a measure of total electric energy you use over a specific period of time
[2]Therms are the actual heat content in the natural gas measured by your meter; or the volume of gas that your natural gas meter records.

2. On Site Materials

a. Counter Card

b. Tenant Card / Rack Brochure (front and back)

Frequently Asked Questions

1. **Can this challenge really make a difference?**
   Yes! If we all work together and do our part, this challenge can have a meaningful impact on energy use, natural resources, and our environment.
2. **Where can I find more tips on saving energy?**
   You can find a list of helpful energy efficiency tips at communitiesforconservation.com or visit energy.gov
3. **Can I let my neighbors know about this challenge?**
   Yes, the success of this contest depends on participation so please spread the word at your complex.
4. **Am I penalized if I don't reduce enough energy?**
   There is no penalty. We only ask that participants reduce where they can and try their best.

Tips to Go the Extra Mile

Inspired to put the Power of Many into action? Then step up and make real changes, share suggestions and motivate others as you participate. Working together is how a challenge becomes a triumph.

- ✓ Invest in a removable low-flow showerhead that can go with you if you move
- ✓ Ask if signs can be placed in laundry rooms promoting cold water wash cycles
- ✓ Ask your apartment manager to install smart features like ceiling fans to reduce A/C costs
- ✓ Compare efficiency progress with neighbors to motivate each other

Compete
Conserve
Save

Help your complex strive toward a grand prize in the challenge to reduce energy and water use!

Plus, you'll win with potentially lower bills and prizes for sharing ideas, tips, or stories at communitiesforconservation.com.

Source:
[1] https://energy.gov/energysaver/how-energy-efficient-light-bulbs-compare-traditional-incandescents
[2] water.usgs.gov/edu/qa-home-percapita.html
[3] US Department of Energy, Office of Energy Efficiency & Renewable Energy (EERE). "Energy Savers: Thermostats." http://energy.gov/energysaver/articles/thermostats. Accessed June 12, 2014.
[4] socalgas.com/save-money-and-energy/energy-saving-tips-tools/tips-for-your-home
[5] US Department of Energy, ENERGY STAR Program. "Computers for Consumers - Savings Calculator." http://www.energystar.gov/index.cfm?fuseaction=find_a_productshowProductGroup&pgw_code=CO>. Accessed June 20, 2014.

This program funded by California utility customers and administered by Southern California Edison Company (SCE), Southern California Gas Company, City of Pomona Water Department, Monte Vista Water District, and Golden State Water Company, and implemented by SCE under the auspices of the California Public Utilities Commission. Program funds will be allocated on a first-come, first-served basis until such funds are no longer available. This program may be modified or terminated without prior notice.

Communities for Conservation

10% CAN MAKE A DIFFERENCE

- Save Resources
- **Enjoy Benefits**
- **It All Starts Here**

The Power of Many... Begins with You

Southern California Edison, SoCalGas® and select regional water companies are calling on people just like you to join your apartment complex in the **Communities for Conservation** challenge. This program focuses on strengthening our resources, reducing our energy use, and uniting our community in powerful ways.

Each participating apartment complex is challenged to reduce its use of electricity and natural gas by at least 10% and water by up to 20% in 12 months — **and your involvement is key to making that happen**. The importance of conservation connects everyone and motivates us to find solutions that work. This is where it can start.

At the end of 12 months, don't be surprised if you enjoy noticeable savings across the board. Plus, you could personally win prizes throughout the year sharing ideas, tips, or stories. All while **helping your complex strive toward a grand prize**. Are you geared up for the challenge? **Let's go!**

Join together and transform the Power of ~~One~~ into THE POWER OF MANY!

Participate, Reduce, and Save

Whether you love a challenge or you just want to be part of something amazing, the **Communities for Conservation** challenge is a program you don't want to miss. Speak to your property manager for details and then get ready to take charge of your energy and water usage.

- **Educate** yourself on ways to cut back and implement those changes
- **Connect** with participating neighbors and show pride in your joint conservation efforts
- **Enjoy** the advantages of participation, which may include noticeable savings from reduced energy and water usage and chances to personally win prizes

Saving is easy as can be. Little changes, such as turning off the water while you brush your teeth; switching to energy efficient light bulbs; washing your clothes in cold water; and shutting off lights can make a huge difference. **And the benefits make everyone a winner.**

Tips on How to Save Energy

Did you know 90% of the energy that incandescent bulbs use is given off as heat?
TIP: You'll use 80% less energy with LED bulbs, plus they last up to 25 times longer.[1]

Did you know typical showers use up to 5 gallons of water/per minute?
TIP: Install a low-flow showerhead to reduce water use.[2]

Did you know you could save up to $135 a year by smartly setting your thermostat in summer and winter months?
TIP: In summer, set the temperature to 78° and in winter set to 68°.[3]

Did you know keeping your A/C's filter clean can save 5-15% on energy costs?
TIP: Check your A/C filter every month and clean or replace as needed.[4]

Did you know smaller cooking appliances use two-thirds less energy than conventional ovens?
TIP: Use microwaves, toasters or pressure cookers for small-to-medium size meals to save energy.[4]

Did you know you could save up to $85 per year by unplugging your HD DVR and HD set-top boxes when not in use?
TIP: Plug your boxes into a smart power strip and then click it off to shut down electricity flow.[5]

*Savings estimates are based on a number of factors and actual savings may vary.

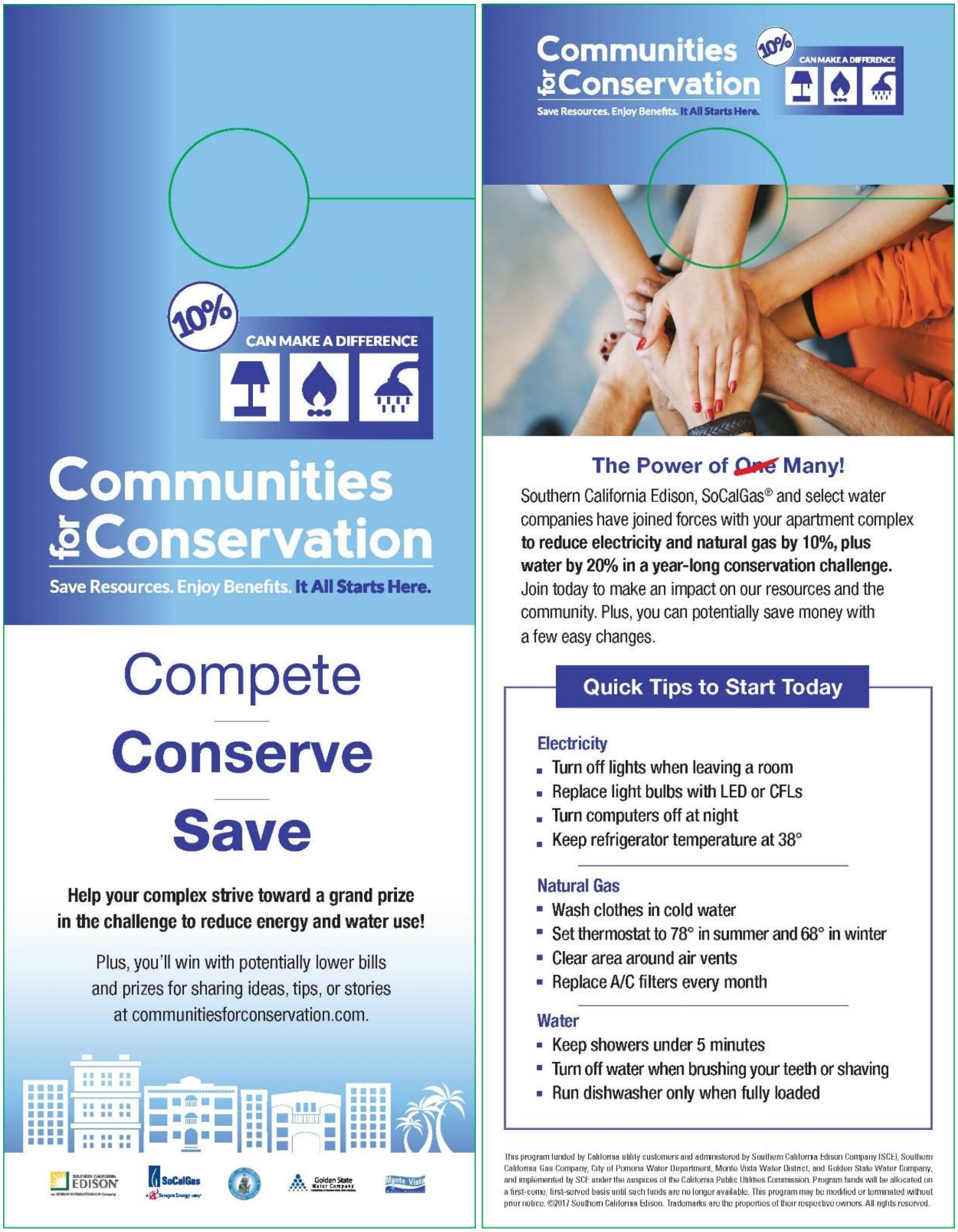
c. Window Cling

d. Outdoor Banner (side by side, full vertical views)

e. Lawn Sign

f. Outdoor Tenant Poster

g. Door Hanger



2 Methodology

2.1 Experimental Design

To identify the effects of competition participation (Treatment A), the pilot randomly assigned MFR properties to the either a treatment group or a control group. A traditional RCT design uses random assignment of participants to a control group and one or more treatment groups after eligibility has been determined. The control group serves as a baseline for comparison and thus, no treatment is applied to this group. A treatment group receives one or more levels of "treatments." Outcomes of the treatment group(s) are compared to the control group in order to infer causality (i.e., draw conclusions about the effects of treatments). In a RED, all eligible participants have the opportunity to participate in the treatment(s), but random subsets of these eligible participants are offered encouragement to participate (in contrast to a pure RCT, where participants do not self-select). That is, participants are allowed to decide whether they want to participate in the treatment(s).

MFR properties were divided into two treatment groups and one control group. Properties allocated to the first treatment group (T1) received competition incentives and Comparative Usage Reports mailed directly to the property manager (Treatment A). Properties assigned to T1 were selected randomly through an RCT design. Properties allocated to the second treatment group (T2) received Comparative Usage Reports mailed to property manager (Treatment A), and only the T2-in received additional competition marketing directed at tenants (Treatment B). These properties were recruited through RED, meaning they were randomly selected to receive on-site marketing but did so only by choosing to opt-in. Properties that opted-in to Treatment B are classified as compliant "T2-in" while those that did not opt-in are classified as "T2-out", and received only Treatment A. Lastly, a group of properties were assigned to a control group that received neither mailings nor onsite marketing. This design identifies the individual effects of Treatment B and Treatment A through comparing outcomes among the T2-in and T1 groups to those of the control group.

The principal benefit of the experimental approach is that it allows causal claims about Treatment A and Treatment B effects on property energy consumption. We evaluate these effects by comparing year-over-year changes in monthly energy use of treated properties to year-over-year changes among control properties. This approach can be characterized as a difference-in-difference evaluation, where savings are estimated by taking the difference in year-over-year consumption among treated properties and subtracting out (differencing) the year-over-year differences among control properties. As such, it ensures that calculated savings reflect only the consumption changes resulting from the treatments, ignoring year-over-year changes that are shared by the control group. Examples of year-over-year changes that this method controls for include secular trends in energy consumption and changes induced by weather that are not accounted for by temperature data.

Indeed, 2017 saw an uptick in California wildfires that could have had an impact on year-over-year consumption of pilot properties. Our difference-and-difference approach mitigates concerns about the effects of these wildfires as long as its impacts were distributed equally among control and treatment groups.

The validity of the difference-in-difference design relies on the assumption that control properties experience trends in energy consumption similar to those of treated properties. To ensure properties in the control group did not differ significantly from those included in T1 and T2, the program implementors stratified the treatment assignment and recruitment along a series of key property attributes.[4] The reader can refer to a previous report for detailed explanation of the stratification design.[5] Section 3 of the current report evaluates the balance of property attributes across treatment and control group by comparing building size, building construction date and average monthly energy consumption.

2.2 Calendarizing Consumption

We constructed monthly consumption data for each property using utility billing data. Because billing data intervals do not coincide with calendar month intervals, we had to translate billing period consumption to monthly-interval consumption through a calendarization process. Calendarization works by dividing billed consumption over monthly units, assigning the shares of billed energy use according the share of the billing period that coincides with each month. For instance, if the electricity bill covers 31 days running from July 9th to August 8th, it includes 23 days in July and 8 days in August. In this case, calendarization assigns 74.2% (23/31) of the total billed consumption to July and 25.8% (8/31) to August. Total calendarized monthly electricity consumption for a given calendar month is the sum of billed consumption assigned to the month.

2.3 Occupancy

The occupancy rate is calculated monthly for each property and it represents the proportion of residential meter-days that are accounted for each month. Drops in occupancy can occur if meter billing periods do not cover an entire month or if a meter reports zero energy use over an entire billing period. For example, suppose a meter has billing data spanning September 15th to 30th but not prior to September 15th. If that were the property's only meter, then the property's occupancy rate for the month of September would be 50 percent. If the property had three other meters with full data coverage, the property's occupancy would instead be 87.5 percent. In summary, a property's occupancy each month (m) is calculated by taking the average occupancy across $j = 1, 2, \ldots, J$ meters as follows:

---

4 Only properties in which the number of meters matched the number of units were eligible for pilot recruitment. The purpose of taking this approach was to reinforce confidence in data quality, although it does impose some selection on the sample.

5 *10-10-10 Sample Design Documentation Memo* October 18, 2016.

$$Occupancy = \frac{1}{j}\frac{1}{D_m}\sum_{j=1}^{J}\sum_{d=1}^{D_m} I(d \in BilledDays_{m,j}) \times I(BillAmount_{m,j} > 0),$$

where the variable $I(\cdot)$ equals one for days in which its argument is true and zero otherwise, and D_m is the total number of days in month m. In our analysis of monthly consumption, we exclude observations with occupancy below 90 percent.

2.4 Energy Use Intensity Calculation

Each property's monthly Energy Use Intensity (EUI) is calculated using the formula

$$EUI = \frac{3.14 \times Electricity_{kBtu} + 1.05 \times Gas_{kBtu}}{FloorArea(ft^2)},$$

where 3.14 and 1.05 are the electricity and gas source multipliers determined by Energy Star. EUI is therefore interpreted as the property's total kBtu energy consumed per building square foot. This definition of EUI is identical to the one used in Energy Star's Portfolio Manager. Normalization of energy consumption by building size allows for comparisons to be made across properties of various sizes.

2.5 MFR Benchmarking

Following methods used by Energy Star's Portfolio Manager, a property's benchmark score is determined by comparing its energy efficiency ratio (*EER*) to the distribution of EERs across the entire portfolio. A property's EER is calculated by taking the ratio of its actual EUI to its predicted EUI:

$$EER = \frac{ActualEUI}{PredictedEUI.}$$

Greater values of EER signal lower energy efficiency. The predicted EUI is determined by first estimating a regression model for property EUI using the 2016 property portfolio data and then using the estimated model coefficients to predict property EUI for each month in 2017. This linear regression model is given by the following equation,

$$EUI_k = \beta_0 + \beta_1 CDD_k + \beta_2 HDD_k + \beta_3 HighRise_k + \beta_4 Pool_k + \varepsilon_k.$$

The variables CDD and HDD represent the number of heating and cooling degree days observed during a given property-month (*k*) and the variable ε represents the error term. The regression accounts for whether the property contains a high-rise building or a swimming pool.

After calculating the EER for each property in the portfolio, a property's benchmark score is determined by its placement in the cumulative distribution of EER scores across the entire portfolio. The cumulative distribution function (CDF) is represented using a gamma function, estimated using maximum likelihood methods. The resulting CDF takes on 100 for the greatest EER scores in the portfolio and 0 for the lowest.

The benchmark score, equal to 1 – CDF, ranges from 0 (least efficient property) to 100 (most efficient property).

2.6 Estimation of Competition Impacts

The purpose of this report is to examine the effect that mailings and competition rewards had on energy consumption. We estimate the average treatment effect of the competition on monthly consumption (Y) by fitting a fixed effects regression to the $i = 1...N$ properties observed over $t = 1...T$ months. An indicator variable assigned to each property-month $I(i \in \tau \cap t > t_\tau)$, abbreviated I_τ, equals one during the months after the initial mailing for properties that were in group $\tau \in \{T1, T2_{out}, T2_{in}\}$ and zero otherwise. The following fixed effects regression estimates the effect of these treatments on monthly consumption:

$$Y_{i,t} = \sum_{\tau \in \{T1, T2_{out}, T2_{in}\}} \beta_\tau I_{i,\tau} + OAT_{i,t} + PropertyMonth_{i,t} + SampleMonth_t + \varepsilon_{i,t} \qquad (1)$$

Changes in monthly consumption owing to weather are controlled for using average outside air temperature (*OAT*) measured by weather stations matched at the zip-code level. *PropertyMonth* and *SampleMonth* represent month-of-year-by-property and month-of-sample fixed effects. The first of these fixed effects controls for each property's seasonal variation in consumption and is identified using data from the year preceding the competition (2016). The month-of-sample fixed effects absorb changes in consumption shared by all properties. In other words, it represents any common trends in consumption that are shared between properties in both the treated and control groups. The coefficient β_τ is the estimated average monthly effect of competition participation, after controlling for variation in temperature, seasonal trends and shared trends across all properties.

The ε term represents random error in the model.

3 Data Summary

The average property that participated in the pilot consumed between 10,000 to 12,000 kWh electricity per month, 550 to 650 therms gas and 195 to 270 CCF water. Table 3.1 lists these averages by the group to which the property was assigned. Gas and electricity data were both available for 2,202 properties; however, water data were available for only 159 properties.

Table 3.1 divides T2 properties into two groups, those who opted-in to Treatment B ("T2in") and those who did not ("T2-out"). A total of 151 properties (25 percent) of the properties invited for T2 opted-in and are therefore included in the T2-in group. On average, T2-in properties used more electricity, averaging nearly 12,000 kWh of monthly electricity compared to the control group's average of 10,000. This difference is likely explained by the fact that T2-in properties were larger than properties in other groups, averaging 28,000 ft^2 in floor area and 33 units, compared to the control group's average of 25,000 ft^2 and 29 units.

Average property attributes for all groups are listed on Table 3.2. The Pool and High Rise variables are binary indicator variables that equal one when a property has a swimming pool or a high-rise building, and zero otherwise; the averages therefore reflect the share of properties that have a pool or high rise in each group (e.g. 0.46 means 46 percent of properties have pools). These variables were included as covariates in the regression equations for calculating property EUIs.

Notwithstanding the statistical differences in building size and electricity consumption among T2-in properties (labeled with ∗), property attributes are roughly identical across treatment and control groups. The equality of attributes across groups supports the validity of the experimental design, which relies on similarity between properties in the control group and those assigned to the two treatments. Additionally, the difference we observe among T2-in properties is not surprising given that this group self-selected into the competition whereas the T1 and control groups were randomly assigned, as discussed in Section 2. Moreover, though these differences are statistically significant they are not exceedingly large in magnitude, representing only a 15 percent difference in electricity consumption and 10 percent difference in building size.

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Table 3.1: Monthly Consumption by Group

	Control	T1	T2-in	T2-out
Electricity (kWh)				
(n = 2,203)				
mean	10,349.28	10,760.82	11,950.77*	10,055.36
difference	-	411.54	1,601.5	-293.91
t-stat	-	1.01	2.18	-0.71
Gas (therms)				
(n = 2,202)				
mean	584.79	588.31	651.01	558.08
difference	-	3.52	66.22	-26.71
t-stat	-	0.16	1.8	-1.2
Water (ccf)				
(n = 159)				
mean	194.99	195.97	268.89	177.1
difference	-	0.98	73.9	-17.89
t-stat	-	0.03	1.91	-0.71
EUI (kBtu/ft^2)				
(n = 2,202)				
mean	30.53	30.35	31.06	30.04
difference	-	-0.18	0.53	-0.49
t-stat	-	-0.33	0.56	-0.79
Benchmark Score				
(n = 2,202)				
mean	52.26	51.03	52.11	50.33
difference	-	-1.23	-0.15	-1.94
t-stat	-	-0.85	-0.06	-1.25
N	991	610	151	451

'he "difference" row gives the average for the treatment minus the average for the control group. The "t-stat" row translates these differences to standard deviations, where a t-stat exceeding 1.96 implies that the difference is statistically significant at the 95-percent confidence level.

Annual and monthly trends in energy consumption have an important influence on our analysis. Figure 3.1 illustrates monthly and year-over-year trends in average electricity, gas and water consumption for all properties. The plots show a small year-over-year increase in electricity consumption during the summer months of 2017 and a year-over-year decline in November and December. The final year of the pilot (2018) saw a significant decrease in electricity consumption during the January to June interval. Overall gas consumption underwent a considerable decline for nearly every month of 2017, and this downward trend persisted into the first two months of 2018. Panel (d) of Figure 3.1 plots average monthly temperatures over this time interval. Average temperatures changed little during the summer, 2017 saw higher temperatures during autumn and lower temperatures during the first two winter months. These patterns suggest that some– though not all– year-over-year changes in energy consumption can be explained by changes in weather.

Table 3.2: Property Attributes by Group

	Control	T1	T2-in	T2-out
Floor Area (ft^2)				
(n = 2,202)				
mean	24,923.34	25,417.28	28,148.5*	24,503.75
difference	-	493.94	3,225.16	-419.59
t-stat	-	0.62	2.19	-0.5
Units				
(n = 2,204)				
mean	29.31	30.53	33.44*	28.48
difference	-	1.22	4.13	-0.83
t-stat	-	1.36	2.64	-0.91
Year Built				
(n = 2,198)				
mean	1967.83	1967.46	1969.44	1968.73
difference	-	-0.37	1.61	0.9
t-stat	-	-0.6	1.31	1.29
Pool				
(n = 2,204)				
mean	0.46	0.5	0.47	0.46
difference	-	0.04	0.01	0.01
t-stat	-	1.7	0.3	0.22
High Rise				
(n = 2,204)				
mean	<0.01	<0.01	<0.01	<0.01
difference	-	<0.01	<0.01	<0.01
t-stat	-	0.18	1.41	1.41
N	991	610	151	451

The "difference" row gives the average for the treatment minus the average for the control group. The "t-stat" row translates these differences to standard deviations, where a t-stat exceeding 1.96 implies that the difference is statistically significant at the 95-percent confidence level.

3.1 Grouping Properties by Attributes

The effect of each treatment on energy consumption may depend in part on the individual attributes of a participating property. Our analysis considers how savings differ across properties of varying baseline energy efficiency and building size, measured by number of units and total floor area. This section briefly discusses how we group properties according to these attributes.

Each property's baseline energy efficiency is characterized by its benchmark score at the start of the competition. We sort properties into four quartiles: *VeryLow*, *Low*, *High* and *VeryHigh*. For instance, VeryLow refers to benchmark scores that fall in the 1 to 24 range, while VeryHigh are those in the 75 to 100 range. Recall that a higher benchmark score implies greater energy efficiency, as explained in Section 2. Panel (c) of Figure 3.2 shows how the number of properties in each benchmark score category varies across the different treatment groups. There are some small differences in the distribution of benchmark scores across groups, though none of these differences is statistically significant.

Figure 3.1: Seasonal Trends for All Properties

Table 3.3 describes quartiles for floor area and the number of units, where VeryLow contains properties with floor areas 6,044 to 14,950 square feet and VeryHigh contains properties with 30,459 to 119,787 square feet. Panels (a) and (b) of Figure 3.2 show that the distribution of these attributes varies slightly across control and treatment groups, though these differences are not statistically significant.

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Table 3.3: Range of Attribute Quartiles

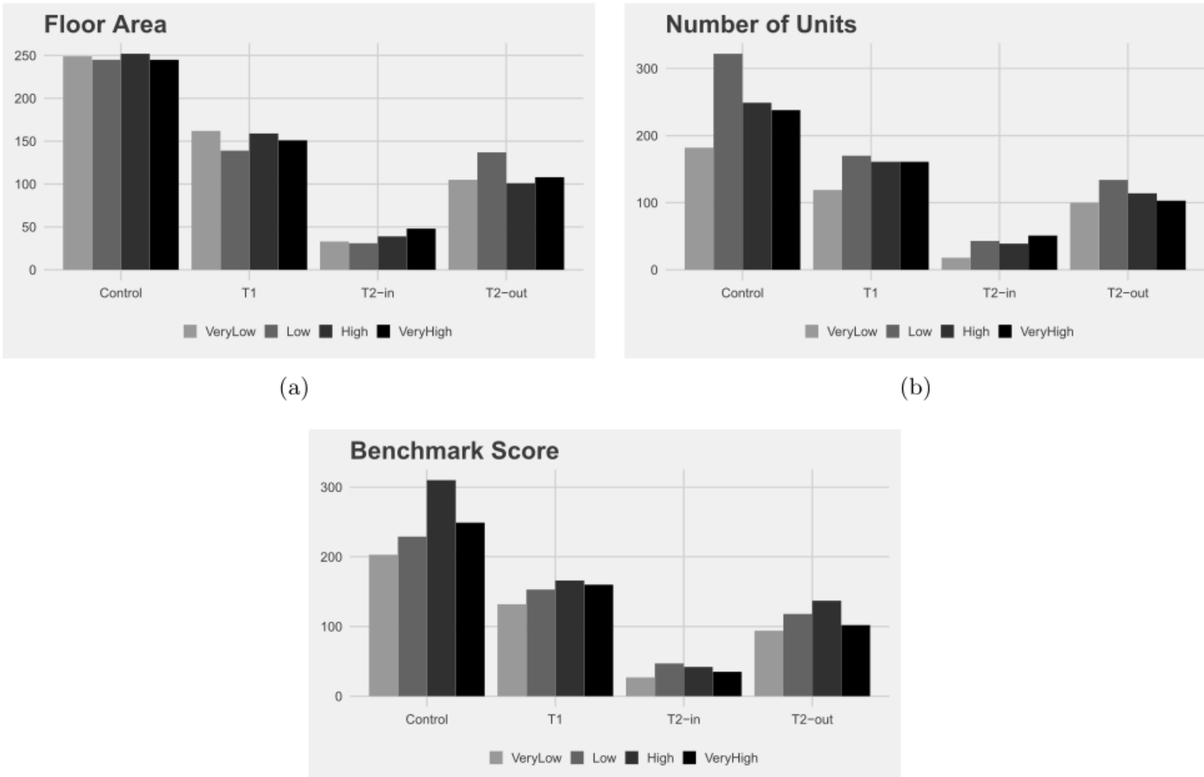
Attribute	Label	Range
Floor Area (ft^2)	VeryLow	6,044 - 14,950
	Low	14,960 - 20,120
	High	20,170 - 30,450
	VeryHigh	30,459 - 119,787
Number of Units	VeryLow	15 - 17
	Low	18 - 23
	High	24 - 35
	VeryHigh	36 - 100
Benchmark Score	VeryLow	1 - 24
	Low	25 - 49
	High	50 - 74
	VeryHigh	75 - 100

The labels "VeryLow" to "VeryHigh" refer to the four quartiles of each attribute as they are distributed in the sample of pilot properties. The third column gives the range of each quartile.

It is possible that property attributes determine effectiveness of the treatments. Property managers learn their benchmark scores from the initial CUR, offering a clear channel for differences in benchmark scores to influence subsequent savings efforts. One possibility is that upon learning of a low benchmark score, managers become motivated to improve their scores, while upon learning of a high benchmark score, they perceive less room for improvement and reduce energy-saving efforts. Social psychologists would classify the latter outcome as an example of the *boomerang effect* (Clee and Wicklund, 1980), defined as the phenomenon in which an encouragement to engage in an activity (e.g. conserving energy) has the unintended consequence of discouraging that same activity.

Building size and unit quantity may also mediate the effects of the treatments. Larger properties, for instance, are likely to have a greater number of tenants, increasing moral hazard. The theory of moral hazard states that when individuals are not the full beneficiaries of their costly efforts, they are less likely to exert effort. In group activities, individual benefits from effort can decrease as a group grows larger, while the costs of individual efforts remain constant. This dynamic has the overall effect of reducing incentives for individual effort among larger groups. More concretely, tenants in larger MFR buildings must share the benefits of competition rewards with a larger tenant community but still face the same costs to reducing personal energy consumption that would be experienced by a tenant in a smaller building. In addition, larger buildings face greater difficulty in coordinating savings efforts among tenants.

Figure 3.2: Comparison of Property Attributes by Group



(a) (b)

(c)

3.2 Data Quality

The scope of this report is limited by the quality of consumption data available to calculate savings. Applying statistical methods to draw inferences from low-quality data can produce false certainty in conclusions that are in fact deeply flawed. Our analysis of data quality, summarized in Appendix A, reveals that the gas and water data have frequent billing adjustments (e.g. negative values), and more sporadic billing intervals. The electricity data, on the other hand, do not have any of these problems. Bearing in mind the lower uncertainty in the electricity data, this report focuses exclusively on estimating electricity savings.

4 Results

4.1 Regression Estimates

Table 4.1 reports monthly savings for electricity estimated using the regression equation described in the previous section. T1 produced an average reduction in electricity consumption of 33 kWh per month during the period after the CUR mailing (May 2017 to May 2018), while T2-in produced a reduction of 98 kWh per month. Given that average consumption ranged from 10,000 to 12,000 kWh per month, these changes represent monthly savings of 0.3-0.4% for T1 and about 0.8-1% for T2-in. In contrast, non-compliers, grouped in T2-out, did not experience any reduction in monthly consumption. Both treatments produced statistically significant effects on electricity consumption, but the estimates show that the tenant marketing delivered to T2-in was over twice as effective at producing electricity savings.

The treatment effects did indeed vary across properties with different benchmark scores. Properties with VeryLow benchmark scores made the biggest changes in energy consumption: among these properties, the T1 and T2-in group achieved monthly savings of 164 kWh and 300 kWh. These changes translate to roughly 1-2% in monthly electricity savings. Changes in electricity use were statistically insignificant among properties with higher benchmark scores. The electricity savings generated from the competition therefore derived primarily from changes among properties that received the lowest benchmark scores on their comparative usage reports– consistent with the boomerang effect discussed in the previous section.

Estimates reported on Table 4.2 describe the competition effects among properties with varying numbers of units. Consistent with the moral hazard hypothesis, these estimates reveal that smaller T2-in properties, with 18-23 units, produces the greatest savings in electricity, amounting for 98 kWh of monthly savings. The treatment effects on T1 and T2-out were weak or non-existent when properties are divided according to number of units.

Table 4.1: Treatment Effect on Monthly Electricity (kWh)

		Benchmark Score:			
	All	VeryLow	Low	High	VeryHigh
	(1)	(2)	(3)	(4)	(5)
T1	−33.233*	−164.409***	8.996	−16.198	35.088
	(18.143)	(52.250)	(38.586)	(29.461)	(23.591)
T2-out	−4.654	90.424	−66.280	−23.061	30.882
	(20.030)	(58.409)	(41.740)	(31.386)	(27.457)
T2-in	−98.131***	−300.683***	−84.244	5.954	−66.650
	(30.882)	(96.163)	(59.215)	(50.423)	(42.153)
Observations	61,126	12,651	15,240	18,183	15,052
R^2	0.993	0.993	0.992	0.993	0.992
Adjusted R^2	0.988	0.987	0.986	0.988	0.985

Note: *p<0.1; **p<0.05; ***p<0.01

Highlighted terms have strong statistical significance. Regressions also included variables for average outside temperature, heating degree days and cooling degree days, evaluated on a monthly basis.

Table 4.2: Treatment Effect on Monthly Electricity (kWh)

	Number of Units:			
	VeryLow	Low	High	VeryHigh
	(1)	(2)	(3)	(4)
T1	−8.086	48.778**	−13.892	−127.900**
	(21.387)	(21.486)	(31.702)	(53.722)
T2-out	30.646	−7.300	−46.370	−4.579
	(22.473)	(23.317)	(35.298)	(62.478)
T2-in	10.625	−98.497***	−100.941*	−49.073
	(45.731)	(37.064)	(53.624)	(81.314)
Observations	11,562	18,552	15,623	15,389
R^2	0.973	0.979	0.979	0.991
Adjusted R^2	0.952	0.963	0.962	0.984
Note:				*p<0.1; **p<0.05; ***p<0.01

Adjusting the regression to include a separate coefficient for each post-treatment month, we estimate separate treatment effects for each month ranging from May 2017 to May 2018. These estimates are plotted on Figure 4.1, where the solid line represents the treatment effect at each month and the dashed line represents the 95-percent confidence interval for each estimate. The T1 and T2-in group achieved the greatest savings during the fall and winter months, November to February. In those months each group reduced electricity consumption by 50 to 600 kWh per month (0.5 to 4 percent). Savings were negligible during all other months that followed the initial comparative usage mailing.

The vertical dashed lines on Figure 4.1 indicate the dates of the competition follow-up mailings, September, October and April. Savings increased largely in the months following the September and October mailings. This observation raises the possibility that the follow-up mailings were effective in encouraging greater savings effort from tenants and managers.

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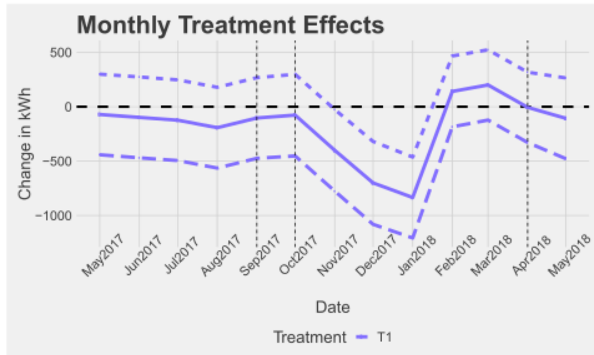
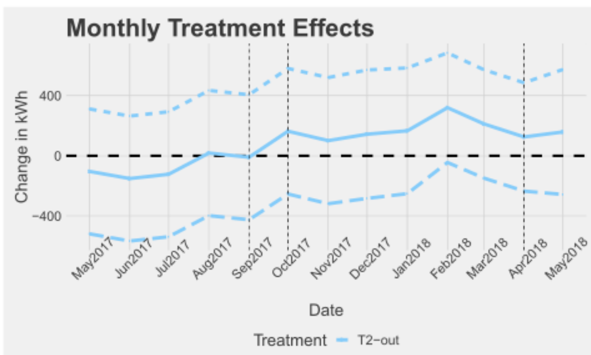
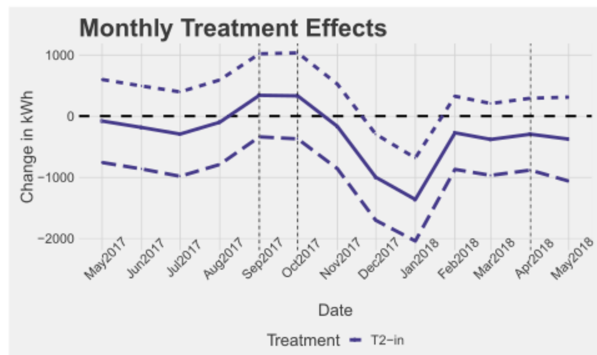
Figure 4.1: Competition Effect on Electricity by Month



(a) T1



(b) T2-out



(c) T2-in

4.2 Savings Calculation

This section calculates aggregate savings for the pilot sample and the SCE service territory by extrapolating from the regression estimates. To keep our calculations conservative, we extrapolate from only the most reliable estimates detailed the previous section. Our prediction of expected program savings across the entire SCE service territory assumes a total of 46,137 MFR properties are recruited to the competition and that the distribution of benchmark scores for these properties is identical to the one in our sample (i.e. 25 percent of properties have benchmark scores of 25 or below). We arrive at the total number of MFR properties based on Res-Intel's mapping of SCE's service territory, detailed in a separate report. [6] Additionally, we assume identical compliance rates for treatment group T2 but also provide predictions that assume full T2 participation (i.e. a non-voluntary version of T2), labelled "T2-Full."

[6] *SCE Residential Expansion: Parcel and Electricity Account Aggregation and EUI & Benchmarking Results Final Report* September 27, 2018.

The regression results summarized in the previous section show that the T1 and T2-in groups saved electricity during the 12 months following the competition start date. Our most reliable savings estimates come from the VeryLow benchmark score group, where changes in consumption from the T1 and T2-in groups are largest in magnitude, statistically significant, and persistent across treatments. Although estimates taken from the entire sample did yield savings in electricity consumption (see Table 4.1), these savings were considerably smaller in both magnitude and statistical significance. When calculating our savings for the sample and service territory, therefore, we rely only on estimated savings from properties with VeryLow benchmark scores, reflecting the most inefficient properties.

Table 4.3 reports actual and predicted one-year kWh and greenhouse gas (GHG) savings for the pilot sample and the SCE service territory. GHG savings are calculated using Energy Star's recommended site-to-source conversion ratio of 3.14. These savings are then converted to GHG metric tons by multiplying them by the EPA's recommended emission factor of 7.44×10^{-4} metric tons GHG/kWh.[7]

Energy reductions among the pilot sample totaled to 260,424 kWh for T1 and 97,421 for T2-in. Although T1 had greater savings, this comparison would have reversed if T2 had recruited a greater number of participants: T2-in properties averaged 3,608 kWh in savings per property, greatly exceeding T1's average of 1,973 kWh per property. Extrapolating these results to the entire service territory yields predicted savings of 23 million kWh for T1 and 10 million kWh for T2-in. However, if we assume full compliance for T2 then its predicted savings rises to 42 million kWh. In terms of GHG emissions, the service-territory predictions translate to a reduction in 53,162 tons of CO_2 for T1, a reduction of 24,306 tons for T2-in and a reduction of 97,226 from T2 with full compliance.

Table 4.3: Estimated One-Year Electricity Savings

	Properties		kWh Reduction			GHG Reduction	
Group	Pilot	Territory	Property	Pilot	Territory	Pilot	Territory
T1	132	11,534	1,973	260,424	22,756,062	608	53,162
T2-out	94	8,651	0	0	0	0	0
T2-in	27	2,884	3,608	97,421	10,404,456	228	24,306
T2-Full	-	11,534	-	-	41,617,826	-	97,226

The "T2-Full" prediction is highly optimistic, assuming full compliance with Treatment B and that the treatment effect per property is equal to the one observed among the T2-in Group. This upper-bound effect size is calculated by multiplying the property-level effect from T2-in (11,330) by the number of territory properties that have VeryLow benchmark scores (11,534).

[7] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

4.3 Exploratory Analysis

This section reviews some of the consumption patterns among pilot properties that may inform the designs of future programs. None of these findings carry statistical significance but nevertheless may still provide insight.

Our exploratory analysis divides pilot properties into two categories:

- **Reducers** Properties that reduced average monthly energy or water consumption during the treatment period compared to the previous year.
- **Non-Reducers** Properties that did not reduced average monthly energy or water consumption during the treatment period compared to the previous year.

Table 5.4: Percent of Properties that Reduced Year-over-Year Consumption

Utility	Group	Reducers (%)	Non-Reducers (%)
Electricity	Control	65	35
	T1	64	36
	T2-out	66	34
	T2-in	70	30
Water	Control	63	37
	T1	61	39
	T2-out	47	53
	T2-in	62	38

Table 4.4 lists the percent of properties that fall into each category for the treatment and control groups. Overall, the majority of properties (60 to 79 percent) reduced consumption across each of the utilities. The T2-in group clearly outperforms the control group (and all other groups) for electricity, containing 70 percent reducers compared to the control group's 65 percent. The treated groups, however, do not consistently outperform the control group for water.

To better understand the composition of energy and water reducers in the treatment groups (T1 and T2), we cross-tabulate the percentage reduction of T1 and T2 reducer properties across key property attributes, including property construction date, number of units and benchmark score. Figures 4.2 and 4.3 use heat maps to plot the distribution of electricity and water reducers across these property attributes.

There are several immediate takeaways from these plots. First, Panel (c) of Figure 4.2 shows that lower benchmark scores have a greater density of high reducers, cutting year-over-year electricity by more than five percent, while those with high benchmark scores are more concentrated at lower reductions of two percent or less. Panel (a) of Figure 4.3 shows large water reductions concentrated among properties built between 1985 and 2003.

Figure 4.2: Water Reducers Distribution

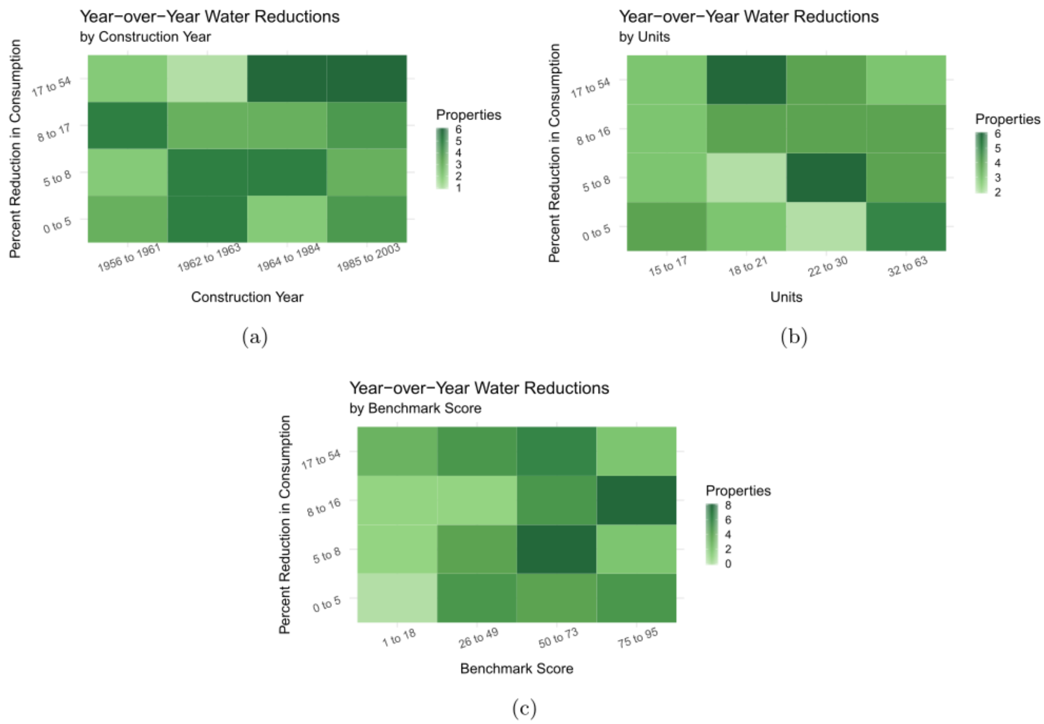
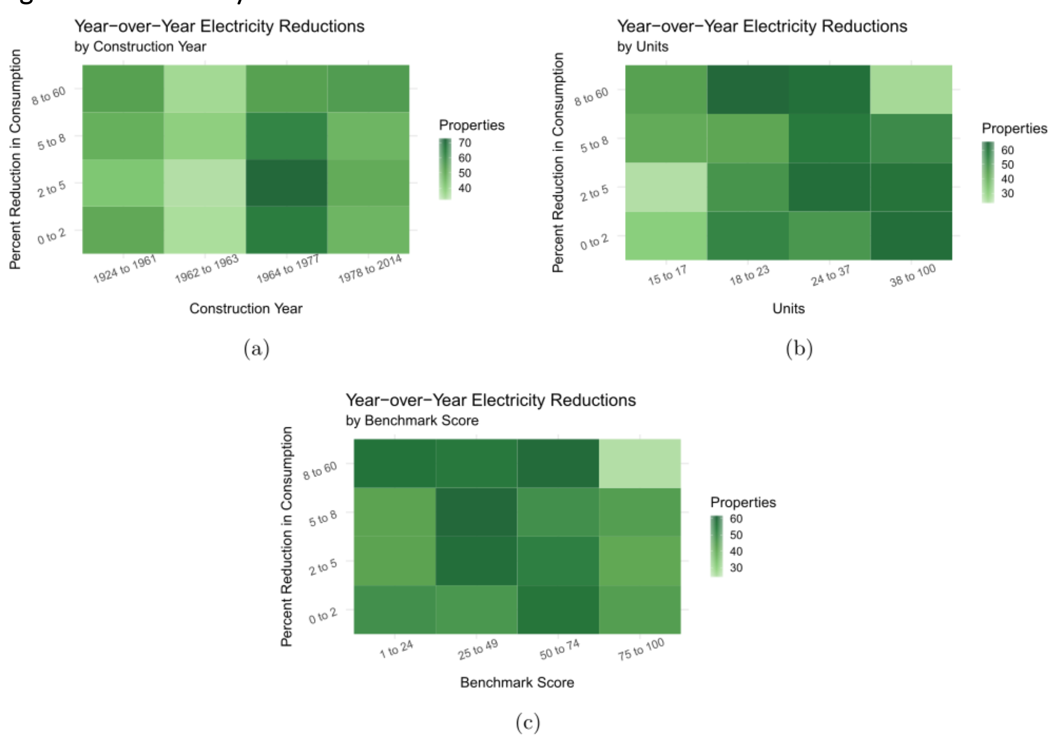


Figure 4.3: Electricity Reducers Distribution



5 Conclusion

The pilot produced statistically significant savings in total energy use, resulting primarily from reductions in electricity consumption. Regressions estimated on various subsets of properties reveal that the magnitude of these savings varied substantially depending on property attributes. Most importantly, our findings suggest that the competition and comparative usage reports had a significantly greater impact on the most inefficient properties, assigned low benchmark scores at the start of the competition. Benchmark scores were determined using EUI measurements, which normalize energy consumption by building size, and further adjusted for weather and property attributes. Future competitions or MFR programs of a similar nature would therefore be well-advised to target inefficient properties, identified using an identical or similar benchmarking method.

The treatment groups were designed to show whether direct mailing to tenants would produce savings beyond those achieved by only contacting property managers regarding comparative usage reports and competition incentives. Our main regression results show that the direct mailing treatment (assigned to group T2-in) is indeed associated with several times more savings. The implications of this finding, however, are not entirely clear because T2-in is a self-selected sample of participants. Indeed, only 25 percent of properties (151 of 602) recruited to T2 opted-in to Treatment B, and opt-in properties tended to be larger in size, consuming more electricity on average. When planning future competitions and mailings, implementors should carefully weigh the benefits of increased savings associated with the more salient T2 design against the disadvantages of its relatively low-participation rate and greater implementation costs.

Our regression analysis also compared electricity savings achieved by buildings of various sizes. The conclusions that can be drawn from this analysis, however, are somewhat tenuous given the relatively small number of properties in our sample. T1 offered little evidence that building floor size affects savings. However, we find that the T2-in group achieved the greatest savings among small buildings with low floor area and fewer units. Greater effectiveness of the competition among smaller MFR buildings may arise because the targeted competition marketing used in T2 is more effective when total building consumption depends of the efforts of fewer residents. This observation is consistent with the theory of moral hazard, or the tragedy of the commons, which says that individuals exert diminished effort towards a group goal as the size of the group grows larger. More conclusive evidence on the effect of building size on competition incentives remains a topic for future study.

The overall average savings achieved among the T2-in group amounts to about 1 percent, reaching a maximum of about 2 percent among the subset inefficient properties. Savings from T1 were more modest, ranging from 0.3 to 0.8 percent. These savings are comparable to those achieved by other similar programs. Most notably, a large-scale program implemented by OPOWER to study the effects of Home Energy Report mailings found that the mailings produced savings of 1 to 3 percent, averaged across a sample of about 600,000 households (Allcott, 2011; Allcott and Mullainathan, 2010). In parallel with our findings, the

OPOWER study found that households with high initial energy consumption were the ones that saved the most after receiving poor ratings on their Home Energy Reports. These similarities exist even though OPOWER targeted homeowners and tenants while CfC primarily targeted property managers with different financial incentives.

Our savings estimates and projections from the pilot (reported on Table 4.3 of Section 4) are derived solely from changes in consumption among the most inefficient properties participating in the pilot. We found that properties with benchmark scores in the bottom quartile contributed an average of 1,973 kWh in savings among the T1 group and 3,608 kWh among the T2-in group. These savings aggregated to a total of 260,424 kWh for T1 and 97,421 kWh for T2-in; and we project savings of 23 million kWh (T1) and 10 million kWh (T2) if the treatments were implemented across the entire mapped service territory.

6 CfC Pilot Innovations and Recommendations

The CfC pilot was an innovative "first-mover" in many ways. Our recommendations for future program delivery flow from these innovative aspects.

1. First, the pilot utilized multiple behavioral mechanisms to encourage conservation behavior.
   - **Competition**: the participating MFR complexes competed to reduce usage
   - **Feedback/Benchmarking**: the comparative usage information for each participating MFR complex against the average usage was reported quarterly
   - **Commitment**: sought 10% electricity, 10% natural gas, and 20%+ water usage reduction from baseline
   - **Follow-through**: asked the apartment renters and property owners/managers to exhibit behavior changes to support energy reductions within the 12-month period
   - **Rewards**: rewards were made available each of the quarters throughout the program. Properties with the largest savings will receive energy-saving prizes. Tenants are also eligible for prizes when they share ideas, tips or photos at CforC.energy (or communitiesforconservation.com).
2. The competition required building energy benchmarking as a simple metric for customers to understand their apartment complexes' energy efficiency. Since benchmarking requires building ft^2 to calculate energy and water intensities, the large-scale nature of the CfC pilot meant that Energy Star Portfolio Manager would not be feasible to use for benchmarking. Res-Intel's mass-scale building energy benchmarking satisfied the pilot requirements for the 2,200 complexes in the pilot.

3. The CfC project tackled the energy and water nexus head-on. The program implementation plan called for 10% savings in gas and electricity, along with more than 10% in water savings. Res-Intel's advanced spatial analytics enabled the pilot to include building water benchmarking as well by remotely calculating outdoor irrigation requirements at each property.

4. Because of the multi-resource scope of the pilot, significant obstacles to data integration had to be overcome. The potential effects of missing building data were reduced by including apartments that had the same number of residential electricity meters as the number of apartment units. Occupancy metrics were created for competition as well as sophisticated address analytics for identifying property managers to communicate with about the pilot.

5. The pilot included interventions for both property owners/managers as well as tenants. The program was unified by a central theme and artwork that included quarterly energy reports, program data sheets, press releases, a pilot kit, recruitment materials, owner/manager emails, incentive mailings plus a host of on-property collateral like lawn signs, door hangers, window clings, posters, rack card brochures, and counter cards. Additionally, there was a multifaceted website that supported program participation:

    - For tenants the website hosted competition results, a forum to post ideas, tips & stories, plus energy saving recommendations and resources
    - For owners/managers the website included competition results, access to secured data energy reports, conservation ideas & tips, plus conservation resources & tools

Recommendations for MFR Competition Program Design and Implementation

Our recommendations for future MFR competitions stem from the innovative pilot design and the energy savings results above.

1. The results in Tables 4.1 show that the bulk of the energy savings from the pilot accrue to customers in the very low benchmark score (worst efficiency) MFRs. Future behavioral MFR programs should target their low efficiency customers in order to cost-effectively save energy. However, in order target this group, each utility will need to perform MFR benchmarking for some or all of their service territory. This is consistent with the trend in the state to benchmark MFR properties.

2. The lack of substantive water savings is likely due to the small number of participating water properties. Only 159 MFRs with water data were included in the pilot, and they were split between the control and two treatment groups. Two of the water agencies' customer data provided for the CfC pilot included very few MFR properties, but thousands of single family and condominium customers' data. This indicates that these utilities don't have adequate data integration to effectively target customers based on their property type and resource usage needs.

3. For water, the small number of properties in each group limited our ability to determine reliable savings estimates. Another reason for the lack of strong results was the influence of California's drought on customer behavior. Governor Brown declared an end to California's drought on April 17th, 2017. This was right as the competition started, and after the baseline period had ended. His announcement was heavily covered in the media, and likely reduced the incentives for customers to conserve water. Water consumption among the sample had trended lower during 2016 because of the drought and likely bounced back some when the drought "ended."

4. The lag in treatment effects (Figure I) means that longer duration competitions would likely result in larger savings. The delay in the initiation of savings at apartment complexes is to be expected as property managers are typically very busy. It is also consistent with the lead-time required to install energy efficiency measures. Each additional mailer served as a reminder to take action, whether behavioral or through installing more efficient equipment.

5. There is substantial room to improve the program design in order to increase savings. Recall that except for the very low efficiency group, there were not consistent statistically significant savings among the other groups. The savings results in Figure II of 1% to 2% for electricity in the very low efficiency group also shows great opportunities for modifications to the competition design. Three recommendations are most important:

    (a) The reward for an MFR competition should be more salient than the $2,500 Energy Star equipment incentives offered in the CfC pilot. Game design principles suggest that prizes should be reflective of the demographics of the participants in the competition. This will maximize the effectiveness of this behavioral intervention,

    (b) Rather than competing against the "average" apartment in the competition, MFR complexes could compete against the complexes in neighboring municipalities, or against a similar nearby MFR complex. Personalizing the competition would also likely increase effectiveness and participation.

    (c) The conservation recommendations on each mailer included 3 suggestions for electricity, gas and water. This likely resulted in "choice overload" which has been shown to lead to indecision and inaction (Chernev et al., 2015). Future competitions should fully utilize the energy and water usage information coming from the benchmarking tool. Benchmarking provides estimates of baseload, heating, and cooling energy use, as well as indoor and outdoor water use. Res-Intel has developed customized conservation recommendations that are the most relevant for each MFR in the competition (i.e.: a pool pump rebate for an MFR with a pool and high baseload energy usage). Presenting 1-2 of the most relevant recommendations would likely increase conservation savings.

Future Research

These recommendations also point to the need for future research on the CfC pilot. The pilot's effects on long term behavior change following the conclusion of the competition need to be measured.
A persistence study would be useful to estimate the long-term behavior change.

Also, we have limited information on the conservation behaviors undertaken by participants. The CfC website gave tenants and property managers a venue for suggestions and the report their own behaviors. For example, tenants installed some low-cost measures including low flow showerheads and holiday light timers. They also changed behavior through using ceiling fan instead of A/C. A survey of conservation of participant attitudes and behaviors would help us understand the range of actions taken as well as their opinions on how to improve the competition going forward.

References

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Chernev, Alexander, Ulf B¨ockenholt, and Joseph Goodman, "Choice overload: A conceptual review and meta-analysis," *Journal of Consumer Psychology*, 2015, *25* (2), 333–358.

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Appendix

A Data Quality

Overall data quality varied greatly across the three utilities. This section characterizes data quality along three measures: (1) the rate of missing meter data, (2) the rate at which suspicious values appear in the data and (3) the rate at which billing intervals do not conform to expectations. The electricity data raise a minimal number of concerns along these measures; in contrast, the gas and water data contain frequent red flags.

Our characterization of data quality flags each monthly meter reading that falls into the following categories:

- **MissingValue**: Meter does not report any consumption value.

- **NegativeValue**: Electric or water meter reports a negative consumption value.
- **BillGap**: The proportion of the month that is not covered by the meter's billing cycle.

- Example: Billing Cycle I is 4/15-5/5 and Billing Cycle II is 5/15-6/15, implying BillGap = 5/31 = 16% for May.

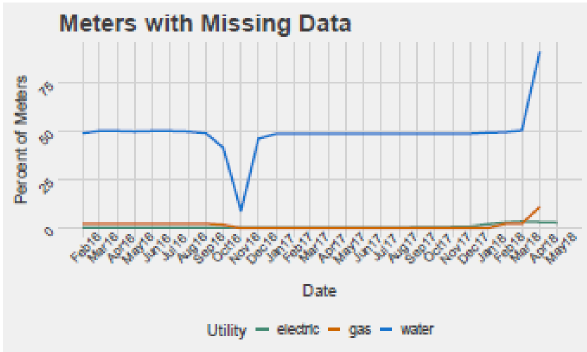
- **BillOverlap**: A TRUE/FALSE variable that indicates if a meter's billing cycle intervals overlap for at least a portion of the specified month.
  - Example: Billing Cycle I is 4/15-5/25 and Billing Cycle II is 5/10-6/10, implying BillOverlap = TRUE for May.

- **Auto-correlation** The correlation between a meter's consumption in the current month and its consumption in the previous month.
  - Takes on a value of 1 (-1) if consumption is perfectly (negatively) correlated and zero if month-to-month consumption is not correlated at all.

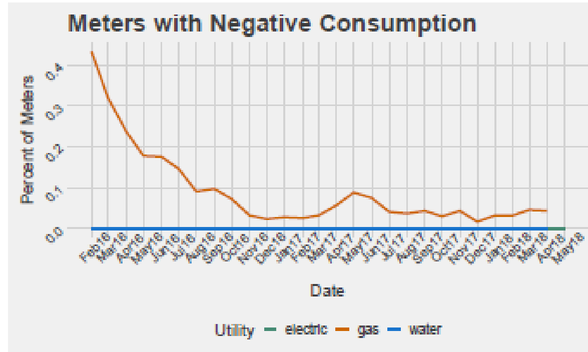
Table A.1 illustrates trends in the incidence of data quality flags for each utility. Panel (a) shows that gas and electricity have a near-zero incidence of missing data for the entire sample period, though missing-rates for both tick up slightly in the final months. Water on the other hand has at least 50 percent missing data for nearly all months of the sample period. Only gas meters report negative consumption values, with rates peaking at nearly 0.5% at the beginning of the sample and gradually sloping downward to about .05% for 2017 and 2018. Overlapping billing cycles are fairly uncommon across all utilities but Panel (c) shows that overlaps do occur for water and gas meters with peak rates of 1 percent and 0.6 percent. Average gas billing cycle gaps hover around 10 percent for much of the sample period and spiked above 60 percent in April. Water meters experienced intermittent spikes in billing gaps in October 2016 and February 2018, but averaged close to zero for most months. In contrast, electricity billing gaps averaged close to zero for all months.

The auto-correlation metric gives some measure of the effect that the preceding data anomalies (and perhaps unidentified anomalies) have on data quality. We expect month-to-month consumption to be strongly correlation within meters and for this correlation to be persistent across the entire sample period. Panel (e) shows that the electricity data meets this expectation, exhibiting an auto-correlation of nearly 1 that persists uniformly across all months. Water and gas data, however, show intermittent drops in consumption auto-correlation. Gas auto-correlation drops from nearly 1 to a low of 0.5 in the period September through December 2017. This is unlikely to be a result of seasonal trends because the same months exhibited auto-correlation near 1 in 2016. So, the drop in auto-correlation almost certainly signals a drop in data quality. Water experiences even more extreme drops in auto-correlation, reaching a low of nearly -0.5 in February 2018. On their own these drops in auto-correlation raise serious concerns about the reliability of gas and water data.

Figure A.1: Data Flag Rates over Time



(a)



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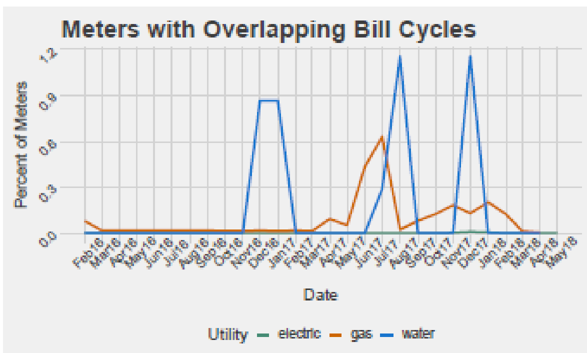

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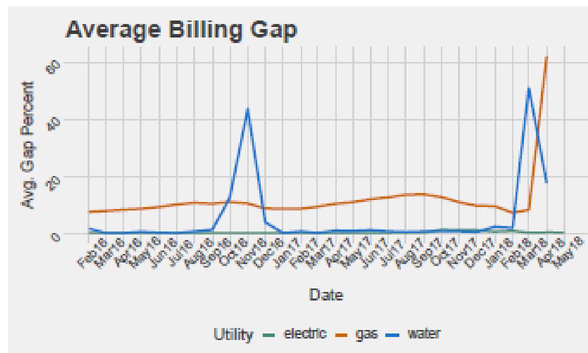
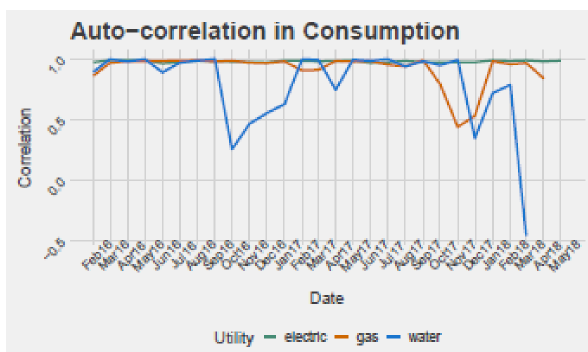


(d)



(e)