

Appendix for *Success, Failure, and Information: How Households Respond to Energy Conservation Goals*

Alastair Fraser*

October 18, 2021

Appendix A Team Power Smart Program Overview

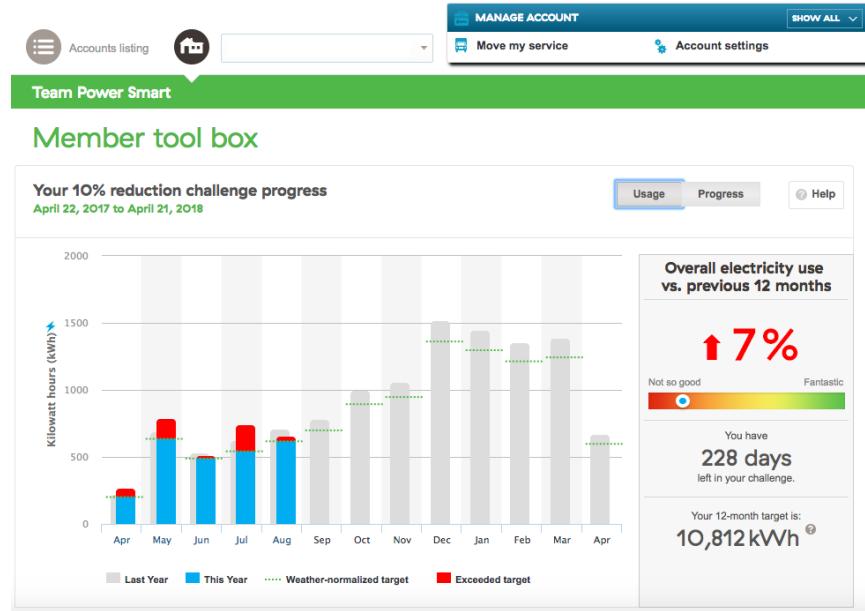
A.1 Online Portal and Sign Up

BC Hydro provides households participating in a conservation challenge with an online portal showing their electricity use and progress towards their target. The online portal includes information on monthly electricity use compared to the same month the previous year and households 10% conservation target. An example is shown in Figure A.1a. In addition to monthly electricity use the online portal displays a household's cumulative progress towards their annual 10% conservation target, Figure A.2b. The way the portal displays information may have changed over the life of the program. It is also possible for households to join Team Power Smart to view their electricity use online without undertaking a conservation challenge. For simplicity, I will use Team Power Smart to refer to those households which also undertake a conservation challenge. I do not observe households which registered online without undertaking a conservation challenge. The reward value for challenges studied in this paper is \$75 CDN. If households re-enrolled in a subsequent challenge after August 2014 they were subject to the updated Team Power Smart Maintenance Challenge rules. This change in program for re-enrolling households specified that if a household had achieved the 10% reduction target, then they will receive a \$25 reward for maintaining last years electricity use [BCH 2014](#). This Team Power Smart update replaced the previous goal of an additional 10% reduction upon re-enrolling. I exclude challenges occurring under the new \$50 reward value.

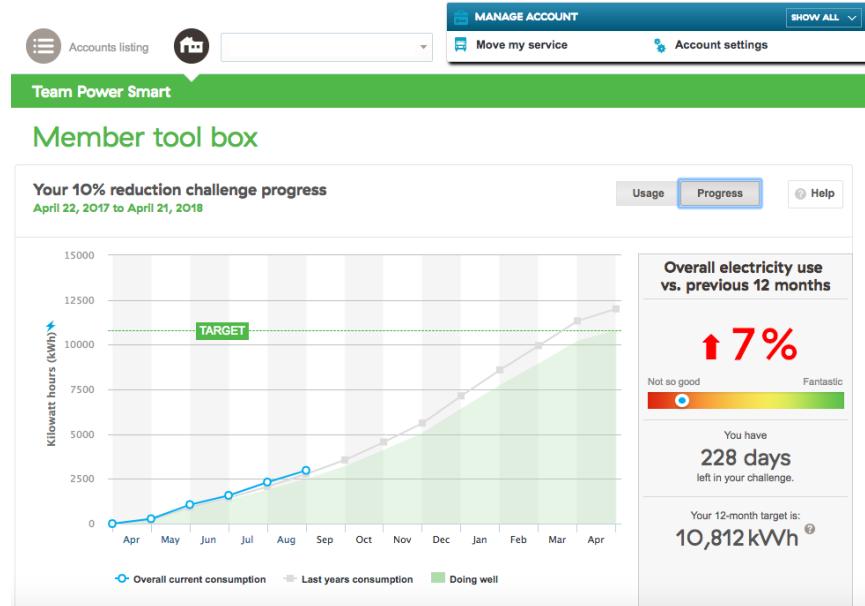
*Email: alastair.fraser@sydney.edu.au
Website: www.alastairfraser.ca

Figure A.1: BC Hydro's Online Member Tool Box

(a) Monthly Challenge Progress



(b) Cumulative Challenge Progress



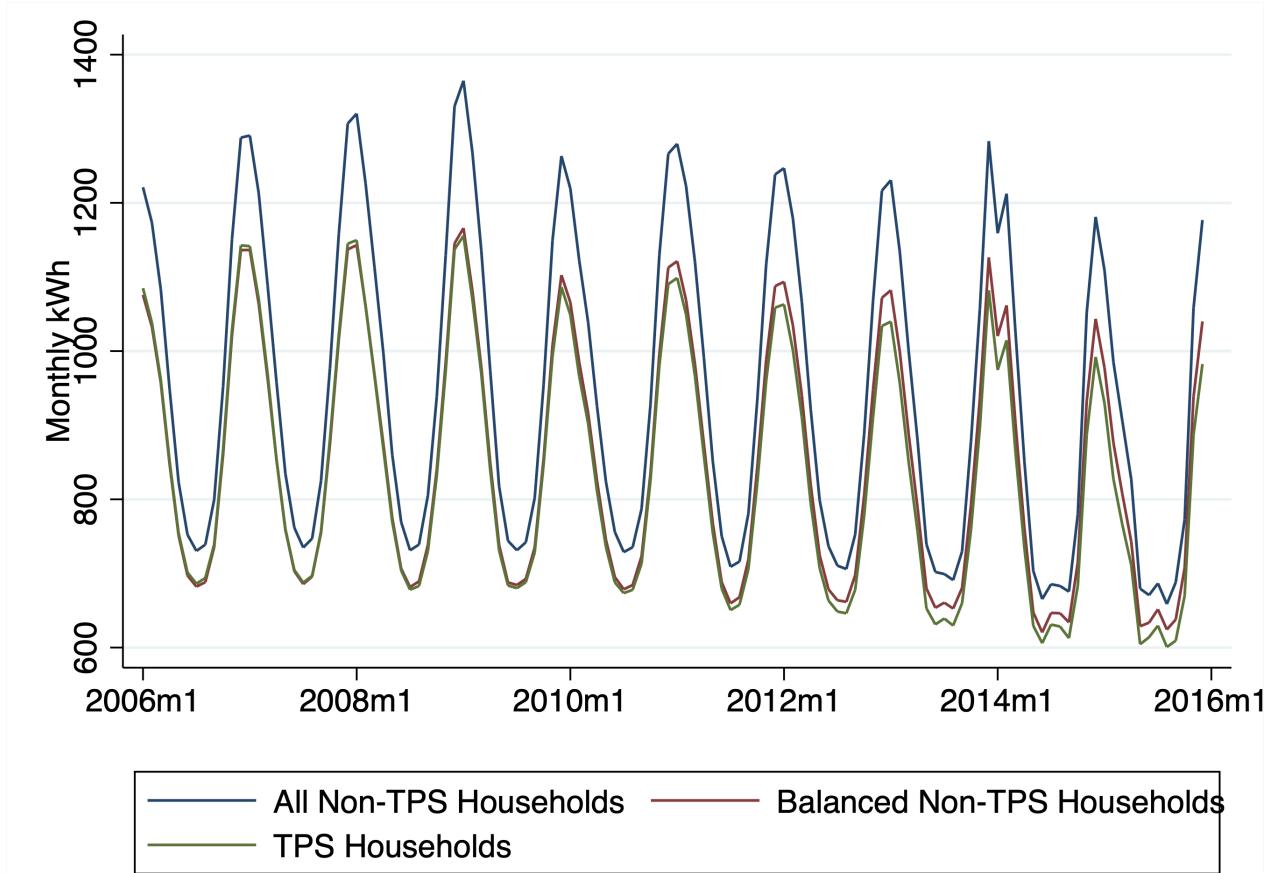
A.2 Data and Household Characteristics

The panel of customers' Team Power Smart program participation history includes the number of conservation challenges, each challenges start and end date, whether the challenge was successful, and a coarse building and heating type for the household. I separately obtained detailed individual household characteristics including building type, assessed value, floor space, number of bedrooms, and the postal code's Forward Sortation Area from the provincial property assessment corporation, BC Assessment. Removing duplicate accounts, erroneous data, dropping households with electricity use more than 5 standard deviations from the mean left a sample of 9,818 households participating in Team Power Smart. In order to only compare households who re-enroll in a second challenge under the consistent rules of an additional \$75 reward and not the new \$50 "Maintenance Challenge", when necessary I further restrict the sample to the 8,877 participants who begin a first challenge before March 2013. This provides 6 additional months in which households can decide to re-enroll in a second challenge before the program reward changed. Results are robust to varying this restriction on the initial sign up date and the gap allowed between re-enrollment. To ensure a closer comparison to treated households I use a random sub-sample of non-participant households with the same composition of building type and heating characteristics as treated (participant) households. The sample of households provided by BC Hydro was a random sample of stable participant households from the British Columbia Lower Mainland region. This region covers 60% of the province's population (BCStats, 2016). Temperatures range from a summer average of 18°C to winters averaging 4°C (ECCC, 2017). Electricity use in British Columbia peaks in the winter due to the widespread use of electricity for heating and the limited use of air conditioning in the summer, and BC Hydro estimates that 46% of residential electricity use in British Columbia comes from electric heating. BC Hydro classifies households into heating categories based on surveys of residents and information on the building where the meter is installed. Non-Electric are households that heat primarily from sources other than electricity. Electric are households that heat primarily from electricity, and Unknown are unclassified households. BC Hydro does not classify heating type based on observed electricity use. Figure A.2 shows the average electricity use for three groups of households. All Non-TPS households is the full sample of control households. These have significantly higher electricity use compared to the average use among TPS (participant) households. However, this difference in average use is almost entirely a composition difference. Balanced Non-TPS Households shows the average use among the random sub-sample of households with the same composition of heating and building type. Electricity use pre-program (2006) and in the early years of the program is very similar between non-TPS and TPS households. Average electricity use declines over time among TPS households, relative to similar non-participants, as expected due to their increasing and potentially repeated participation in the program.

To directly compare electricity use between the full samples of participants and non-participants I estimate the specification

$$y_{it} = \beta_1 TPS_i + \beta_2 BuildingType_i + \beta_3 Heating_i + \epsilon_{it}$$

Figure A.2: Time Trends in Electricity Use



Notes: This figure shows average monthly electricity use for three groups of households. All non-TPS (control) households is the full set of non-participant households. Balanced Non-TPS Households is a random subset of all control households that have the same heating and building type distribution as TPS participant households. TPS Households shows average use among the sample of TPS participants.

Table A.1: Pre-program electricity use and composition differences

| | (1) | (2) | |
|------------------|-------------------------------------|----------------------|--|
| | Dependent variable: Electricity use | | |
| TPS | -87.54*** (6.317) | 9.396* (5.294) | |
| 1 Sty Sfd | | 0 (.) | |
| 2 Sty Sfd | | 49.33*** (6.832) | |
| 1.5 Sty Sfd | | -3.586 (12.96) | |
| Strata Apartment | | -828.6*** (8.360) | |
| Strata Townhouse | | -326.7*** (7.902) | |
| Other | | -123.4*** (13.07) | |
| Non-elec heat | | 0 (.) | |
| Elec heat | | 554.1*** (6.702) | |
| Unknown heat | | 34.09*** (7.982) | |
| Constant | 971.8*** (3.908) | 857.4*** (4.515) | |
| Observations | 348816 | 348816 | |

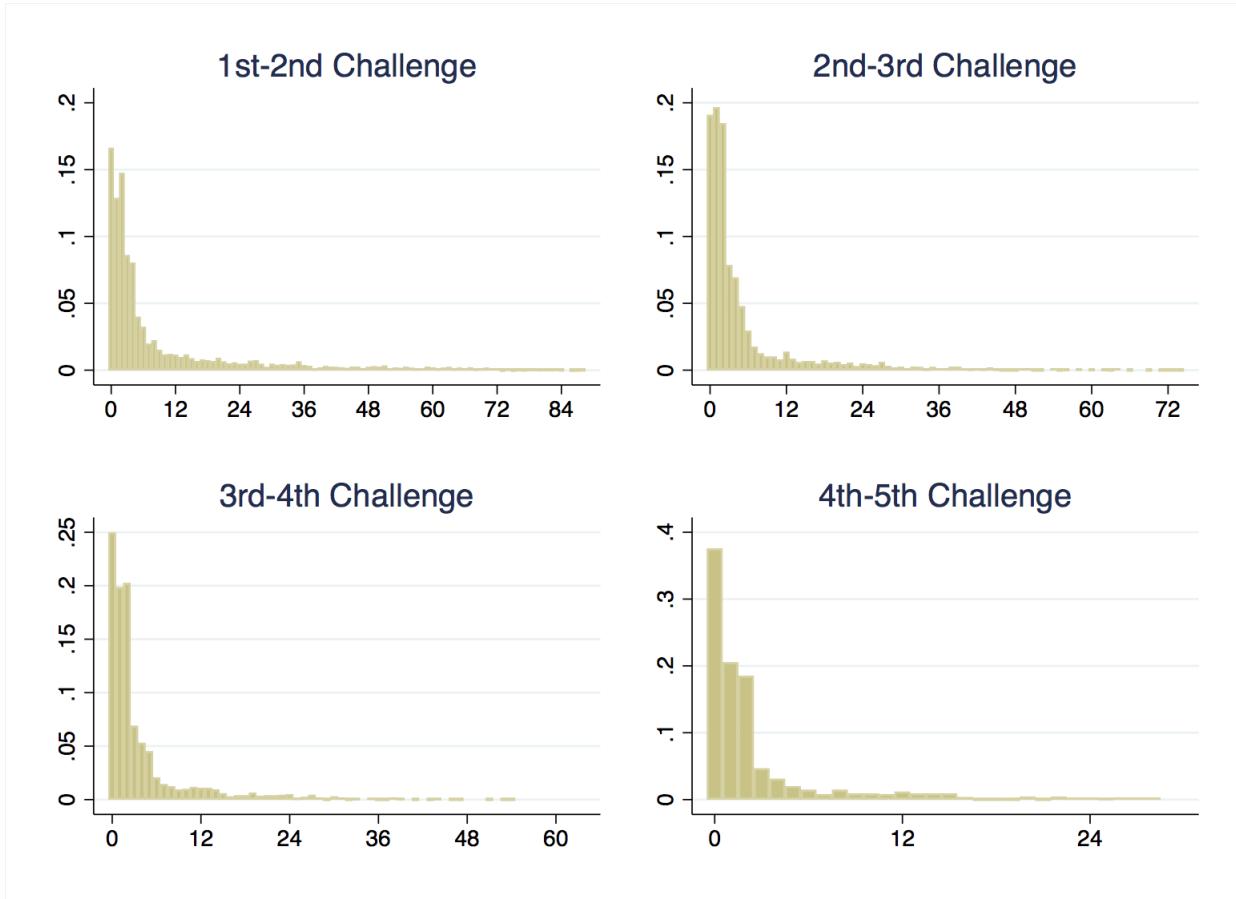
Notes: TPS is an indicator equal to 1 of a household is a participant in Team Power Smart. 1 (2, 2.5) Sty Sfd is a Single (Two, Two and a half) Story Single Family Dwelling, Non-electric heat are homes that heat primarily without electricity compared to Electric heat which are homes that heat primarily with electricity. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

where y_i is electricity use in kWh, TPS is an indicator for program enrollment, and $BuildingType$ and $Heating$ are indicators for the building types and electric vs. non-electric heating type. I estimate this for the 12 months of 2006 across all households and I cluster standard errors at the household level. Results in Table A.1 show that once building characteristics are controlled for, the coefficient on TPS is of small magnitude and is only significant at the 10% level. This indicates that differences in average use between participant and non-participant households are largely due to differences in the composition of household structure and heating type.

A.3 Strategic Sign Up

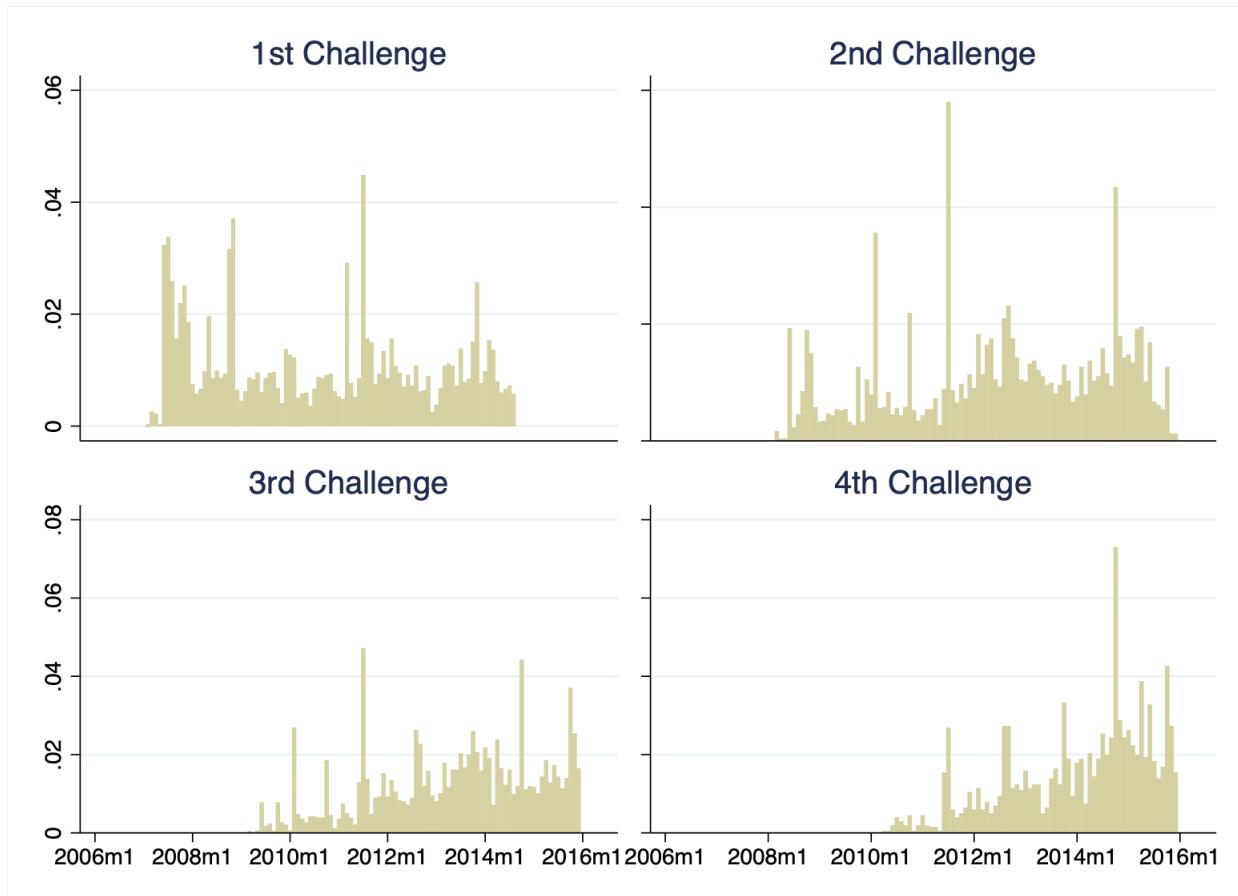
Households could in theory increase their electricity use (or stop any ongoing efforts to reduce their electricity use) to create a new higher baseline that would make their subsequent conservation challenge easier to achieve. Figure A.3 shows no obvious evidence of this; most households, if they continue to additional challenges, begin their next challenge in the first 3 months immediately after completing their prior challenge and there is no obvious bunching at 12 months. The option to undertake a subsequent challenge does not expire; households can sign up for another challenge immediately or postpone indefinitely. Figure A.4 shows the distribution of start dates for challenges one through four. New households continually enroll in TPS throughout the panel and as time proceeds households that complete challenges continue to subsequent conservation challenges. Several dates show large increases in sign-ups; these are likely due to periods of significant promotion of the TPS program by BC Hydro as they do not coincide with households having previous months of unusually large or small electricity use, or experiencing unusual changes in weather.

Figure A.3: Delay Between Conservation Challenges



Notes: These histograms show the number of months households wait between conservation challenges. The majority of households which continue to additional challenges do so shortly after completing their prior challenge. The median wait after the 1st challenge is 3 months, 2 months after the 2nd challenge, 2 months after the 3rd challenge, and 1 month after the 4th challenge.

Figure A.4: Distribution of Challenge Start Dates



Notes: These histograms show the start date for conservation challenges one through four. Several dates show large increases in the number of households starting a challenge. Periods of increased sign up do not coincide with unusual weather, seasons, or consumption, and are likely due to periods of promotion of Team Power Smart by BC Hydro.

A.4 The Weather Adjustment

The weather-adjustment algorithm used by BC Hydro resulted in large adjustments to households' electricity conservation beyond those necessary to correct for weather changes. Adjusting for weather is not an exact science. Some households heat with electricity more than others, some households that do not principally heat with electricity — and so are defined as non-electric heat households — still make significant use of electric heat via baseboard heaters, and household-specific characteristics like insulation or the number of residents will drive large differences in the use of electricity in response to weather changes. The weather-adjustment algorithm used to calculate credited changes was updated in 2014; I exclude challenges occurring under the updated weather-adjustment algorithm. The weather adjustment was applied to the baseline used to calculate households' credited reductions. Because of this, households were not aware of the magnitude of weather adjustment applied to their credited conservation.

The first panel of Figure A.5 shows a histogram of the difference in absolute percentage points between credited and billed changes in electricity use during a household's initial conservation challenge. This is the difference between the reductions in electricity use households were told they achieved and the reductions in physical electricity use that actually occurred. These differences are not small; they have a mean of -0.43% and a standard deviation of 4.2%. In the second panel I show the difference between credited changes used to evaluate a household's success and changes in electricity use using an updated algorithm where the effect of weather on electricity use has been removed as currently recommended by BC Hydro. These have a mean of -0.4% and standard deviation of 5.0%. This shows that the weather adjustment caused many households to receive shocks to their electricity conservation beyond that necessary to adjust for changes in weather. These shocks are comparable in magnitude to half of a households' 10% conservation goal.

Appendix B Event Study Design

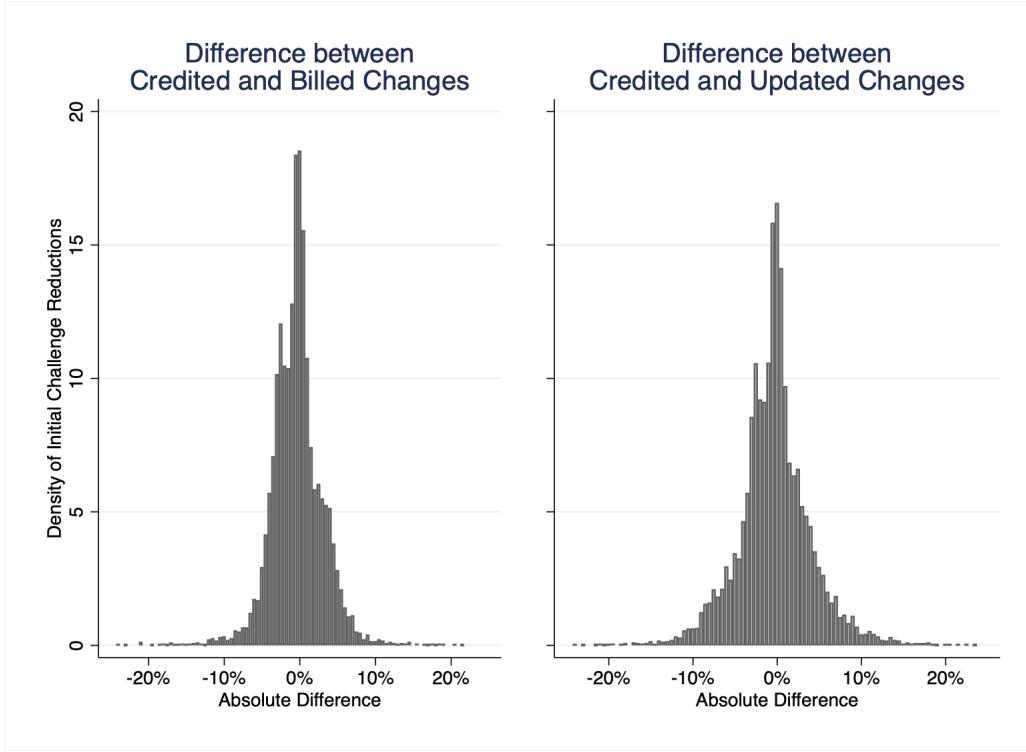
B.1 Parallel Trends Assumption

The parallel trends assumption requires that trends in electricity use between treatment and control households would be the same in the absence of treatment. To compare trends in use between control and participant households leading up to their participation I estimate the following specification,

$$y_{it} = \beta_0 + \beta_1 m_t + \beta_2 m_t \times TPS_i + \beta_3 TPS_i + \epsilon_{it} \quad (1)$$

where y_{it} is log monthly electricity use, m_t is the month-of-year date, and TPS_i is an indicator equal to one if household i is a Team Power Smart participant household. The only pre-treatment period available to all households is the year 2006. To test trends over multiple years I estimate specification (1) for several different time periods and include only participant households that do not begin a conservation challenge until 6 months after the initial pre-treatment years indicated. Table B.2 shows

Figure A.5: Weather Adjustment Discrepancies



Notes: The left panel, Credited and Billed changes, is a histogram of the absolute difference between the changes in electricity use credited to a household after applying the initial weather-adjustment algorithm and the changes in their billed electricity use. The right panel, Credited vs Updated Changes, is the histogram of differences between credited changes and changes in billed electricity use after the effect of weather has been removed using the updated weather adjustment algorithm. Differences are in percentage points such that a 10% Absolute Difference is equivalent in magnitude to the 10% conservation target.

Table B.2: Pre-Program Trends in Electricity Use

| | (1) | (2) | (3) | (4) | (5) |
|--|-----------|-------------|-------------|-------------|-------------|
| β_1 : Date | -0.00029* | -0.00039*** | -0.00040*** | -0.00065*** | -0.00054*** |
| | (0.00015) | (0.00010) | (0.00008) | (0.00007) | (0.00006) |
| β_2 : Date \times Participants | 0.00031 | 0.00004 | 0.00004 | -0.00004 | 0.00014 |
| | (0.00021) | (0.00016) | (0.00013) | (0.00012) | (0.00012) |
| Pre-Program Years | 2 | 3 | 4 | 5 | 6 |
| Non-Participant IDs | 8877 | 8877 | 8877 | 8877 | 8877 |
| Participant IDs | 6779 | 5478 | 4610 | 3639 | 2163 |
| Observations | 375743 | 516779 | 647375 | 750959 | 794879 |

Notes: β_1 : Date is the pre-program time trend common to participant and non-participant households. β_2 : Date \times Participants is the additional time trend specific to participant households. Pre-Program Years is the length of time for which time trends are estimated and excludes all households that start a challenge within six months after the given pre-program. The six month period is to avoid pre-treatment trends that could include anticipation effects in the final months pre-treatment. Standard errors in parentheses clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1.

the results where β_1 is the percent change per month for non-participant and participant households and β_2 is the additional monthly percent change for participant households. Participant households do not have a different, at the 1% level, pre-treatment trend from non-participants. The magnitude of diverging time trends is also small. Taking the largest point estimate of different trends, $\hat{\beta}_2 = 0.00031$ and assuming this difference in trend continues would imply a bias in estimated energy conservation of only 0.4% at the end of the first conservation challenge. Note that this comparison does not rule out the potential for short-run anticipation or other self-selection which can bias event study estimates.

The statistically significant estimates in the last few months prior to a challenge officially beginning may be evidence of anticipation or self-selection. To help understand the pre-challenge dip I approximate the bill averaging effect as follows. I assume households start a challenge uniformly within a billing cycle and immediately begin exerting their full conservation effort. I assume a uniform 2 month billing cycle and that a conservation challenge start is recorded at the start of month closest to the sign-up date. For example, signing up on August 10th would be recorded as a August 1st start and August 20th sign up as a September 1st start; this is consistent with what BC Hydro typically did. This means that by the official 'start' at the beginning of a month half the households have already begun exerting effort, while others will not be exerting effort for up to two weeks past their official recorded start. Combining the uncertain sign-up date with the calendarized 2 month billing cycle results in the first month (t_0) credited to a challenge having 15/16 of the full treatment effect, the first month pre-challenge (t_{-1}) having 1/2 of the full treatment effect, and the second month pre-challenge as being 1/16th of the full treatment effect. Comparing this with the estimates for the two months pre-challenge from Figure 1 indicates that bill averaging could potentially explain most if not all of the pre-challenge dip, though only at the upper end of the confidence interval for the estimated 2nd month pre-challenge.

B.2 Event Study Robustness Checks

This section presents several event study robustness checks. Figure B.6 plots the event study estimates of equation 1 estimated without non-participant control households. This exploits variation in timing in when a household starts their first conservation challenge; households starting a challenge later in the panel serve as the control population for households that undertake a challenge earlier in the panel. Figure B.6 shows that the pre-treatment trend is not due to diverging trends between participant and non-participant households. Confidence intervals are larger due to the lack of non-participant households for identifying date fixed effects. Figure B.7 plots estimates including the full set of non-participant households, instead of the random sub-sample of non-participant households with the same composition of building type and heating characteristics as participant households. Figure B.8 plots estimates using an alternate baseline period of the third year prior to the initial conservation challenge, instead of the second pre-program year.

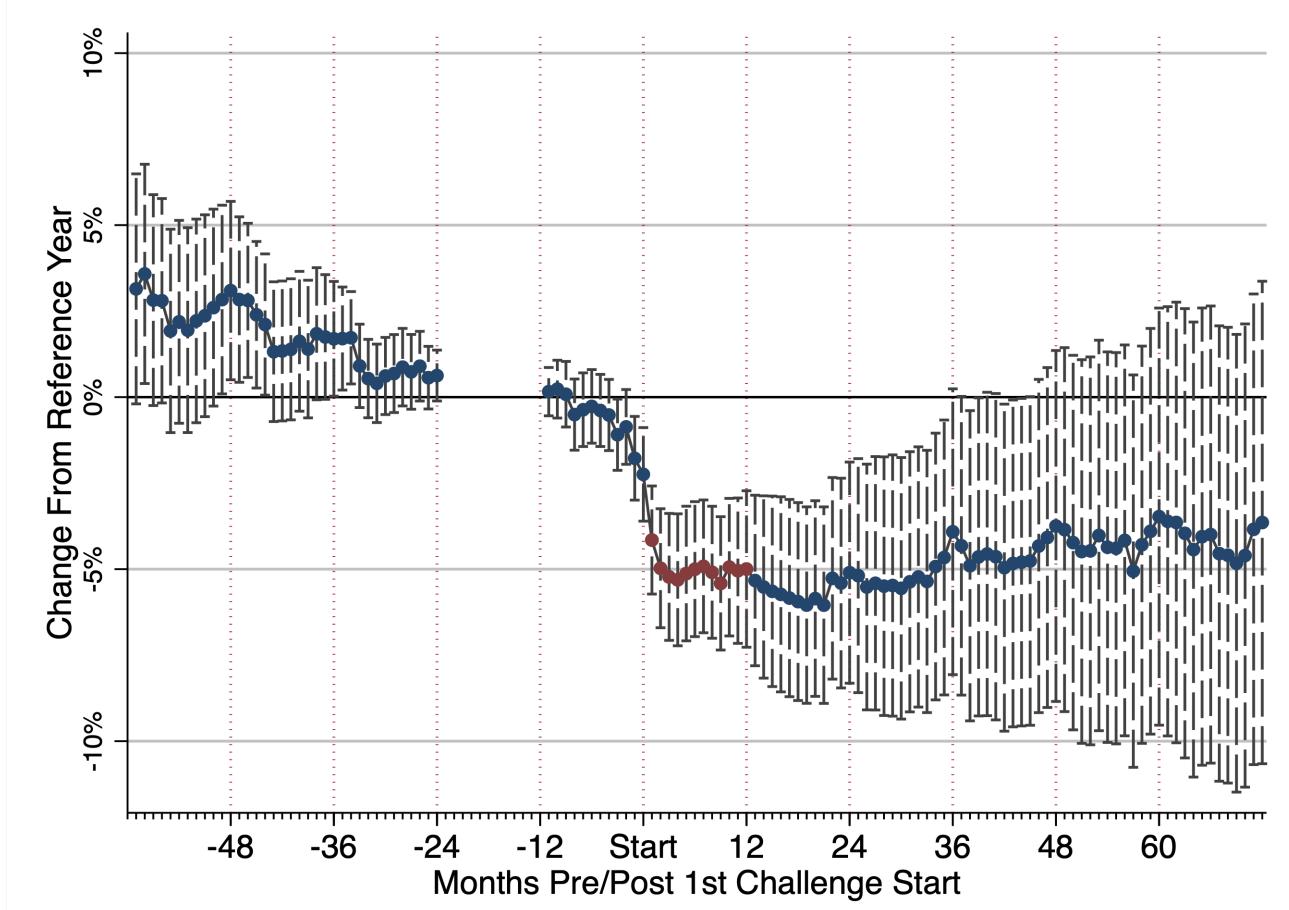
In case time trends differ by household type I estimate my main specification of equation 1 modified to include separate time trends. Figure B.9 plots estimates including separate month-of-year fixed effects by electric and non-electric heating type, and B.10 includes separate month-of-year fixed effects for each building and heating type.

B.2.1 Event-study estimates for re-enrolling comparisons

Figure B.12 plots all estimates for households undertaking separate numbers of challenges on the same plot to provide an alternative comparison of their respective trends.

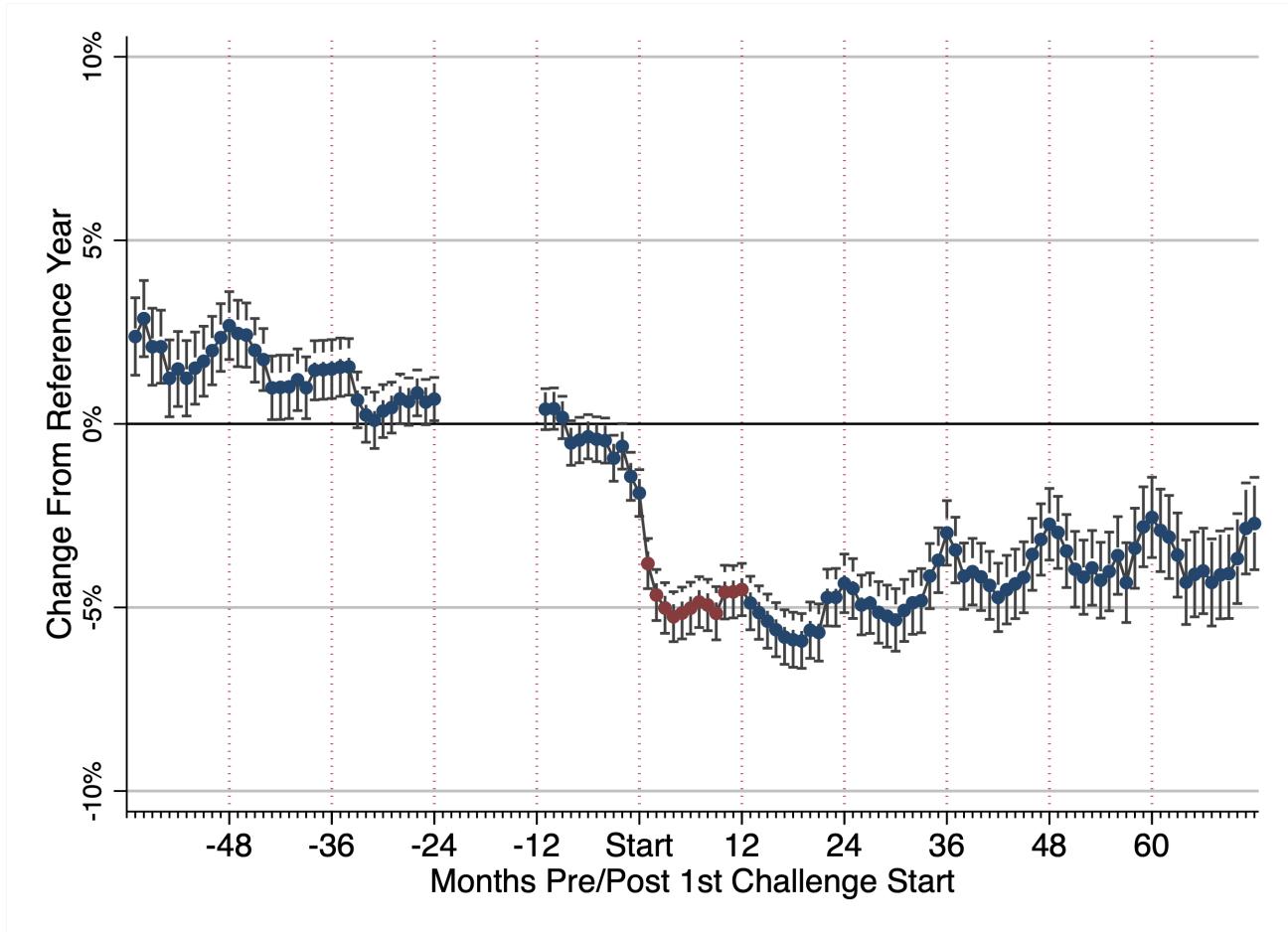
Figures B.13 to B.15 present the panels of Figure 1 separately for clarity.

Figure B.6: Estimated Treatment Effects For Participant Households Only



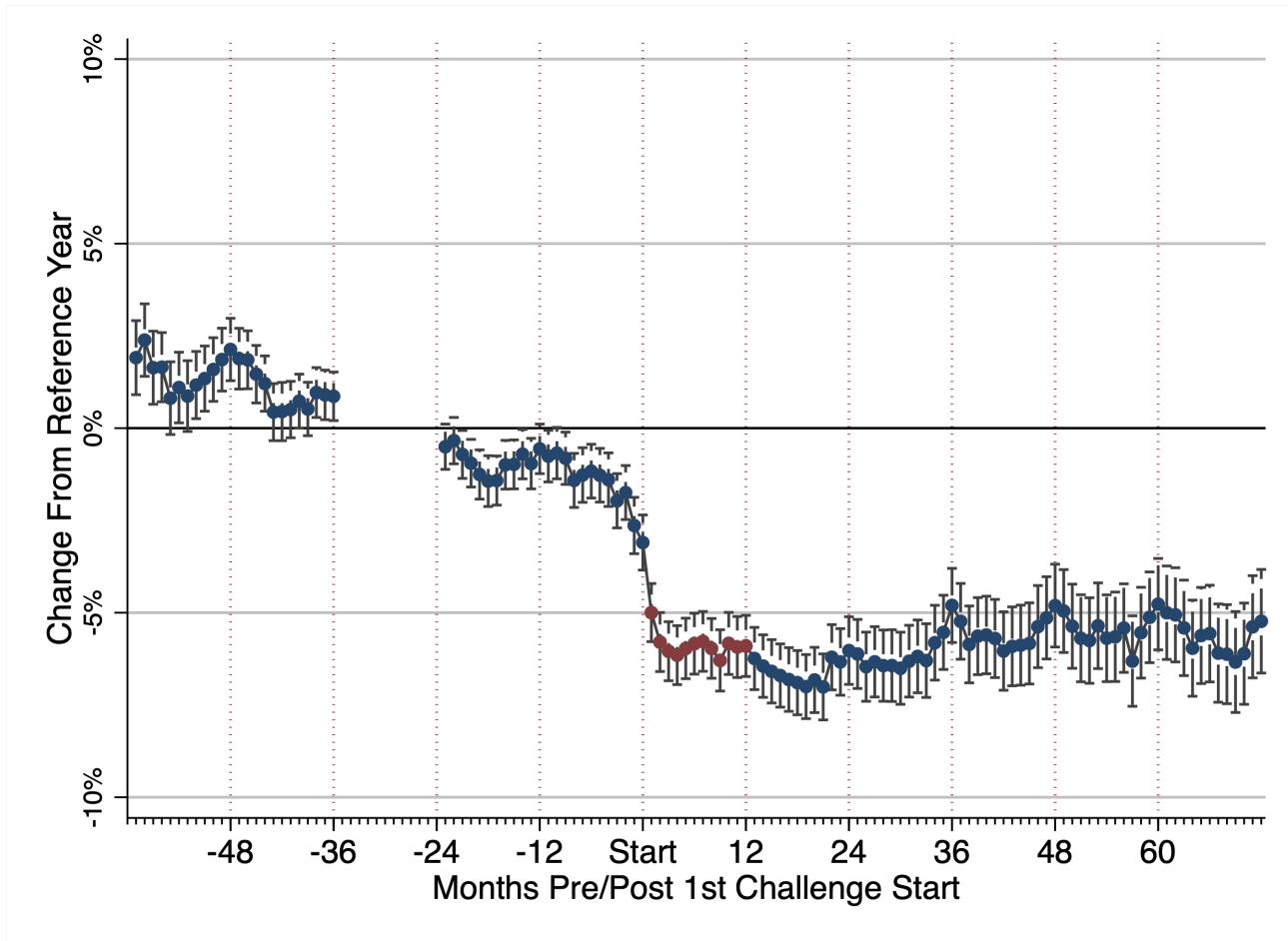
Notes: Estimates of $\hat{\beta}_\tau$ and 95% confidence intervals from equation 1 estimated for participant households only. Estimates $\hat{\beta}_\tau$ are ordered by event-time τ and point estimates in red denote the 12 months of the initial conservation challenge. The gap between -11 and -23 is the excluded reference period.

Figure B.7: Including All Non-participant Households



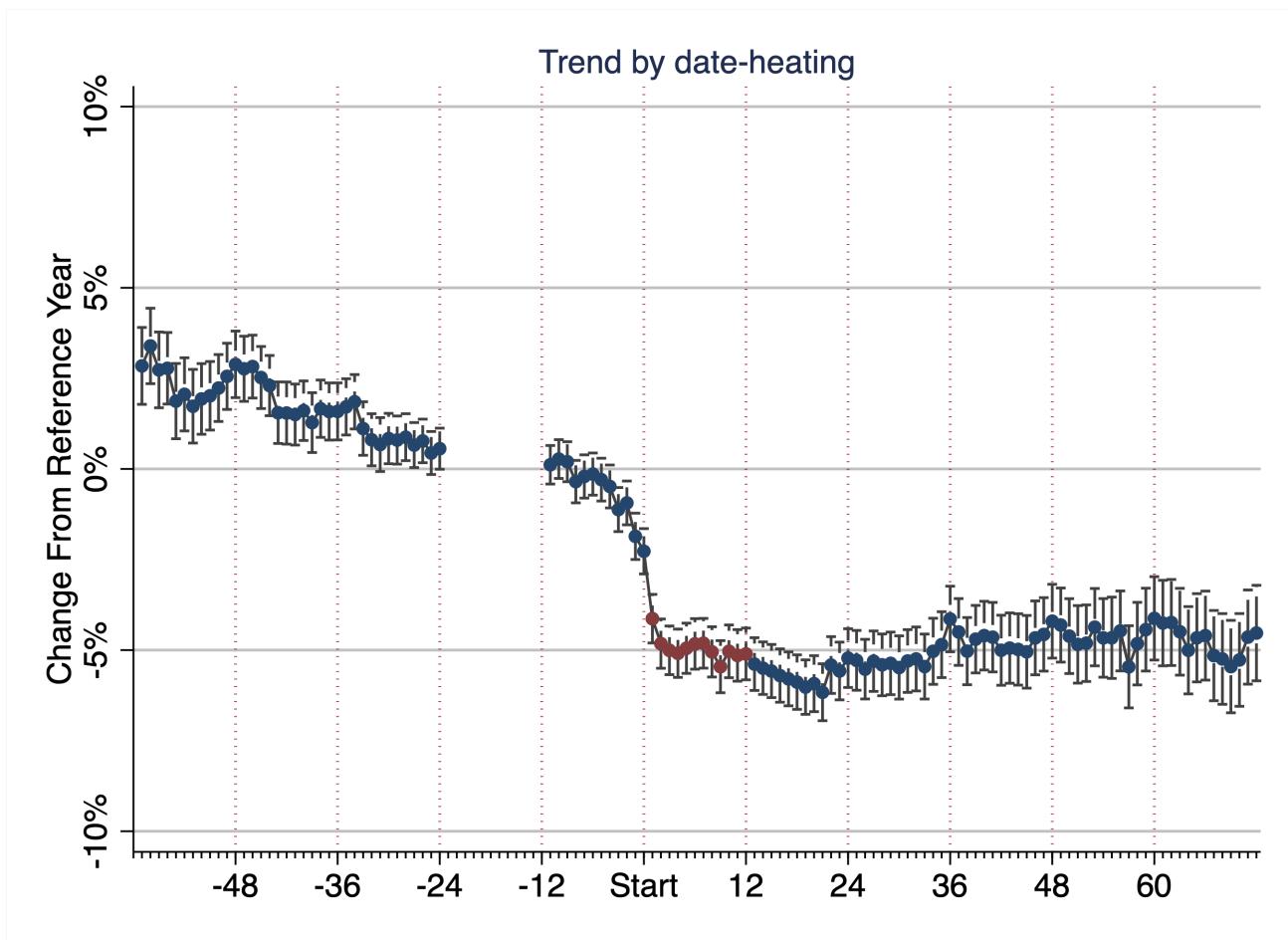
Notes: Estimates including all non-participant households. The additional within-year variation in this figure arises due to the higher share of electric-heating households among the set of non-participant households, compared to program participants. Electric heating households have higher seasonal variation than non-electric households which through common date fixed effects results in a residual seasonal variation.

Figure B.8: **Alternate Reference Year**



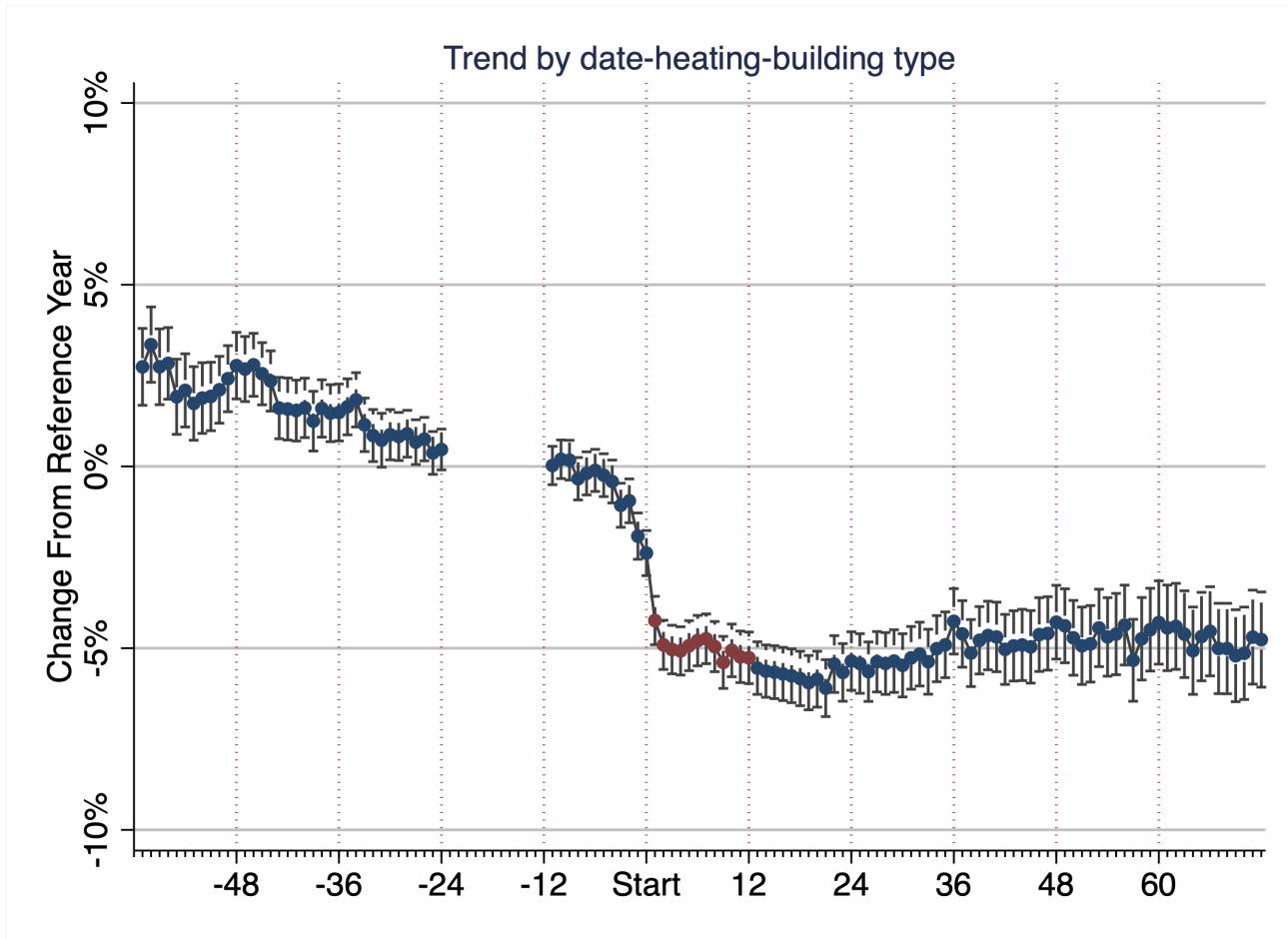
Notes: Alternative reference baseline of the 3rd year pre-treatment: months $\tau = -24$ and $\tau = -36$.

Figure B.9: Date-heating time trend



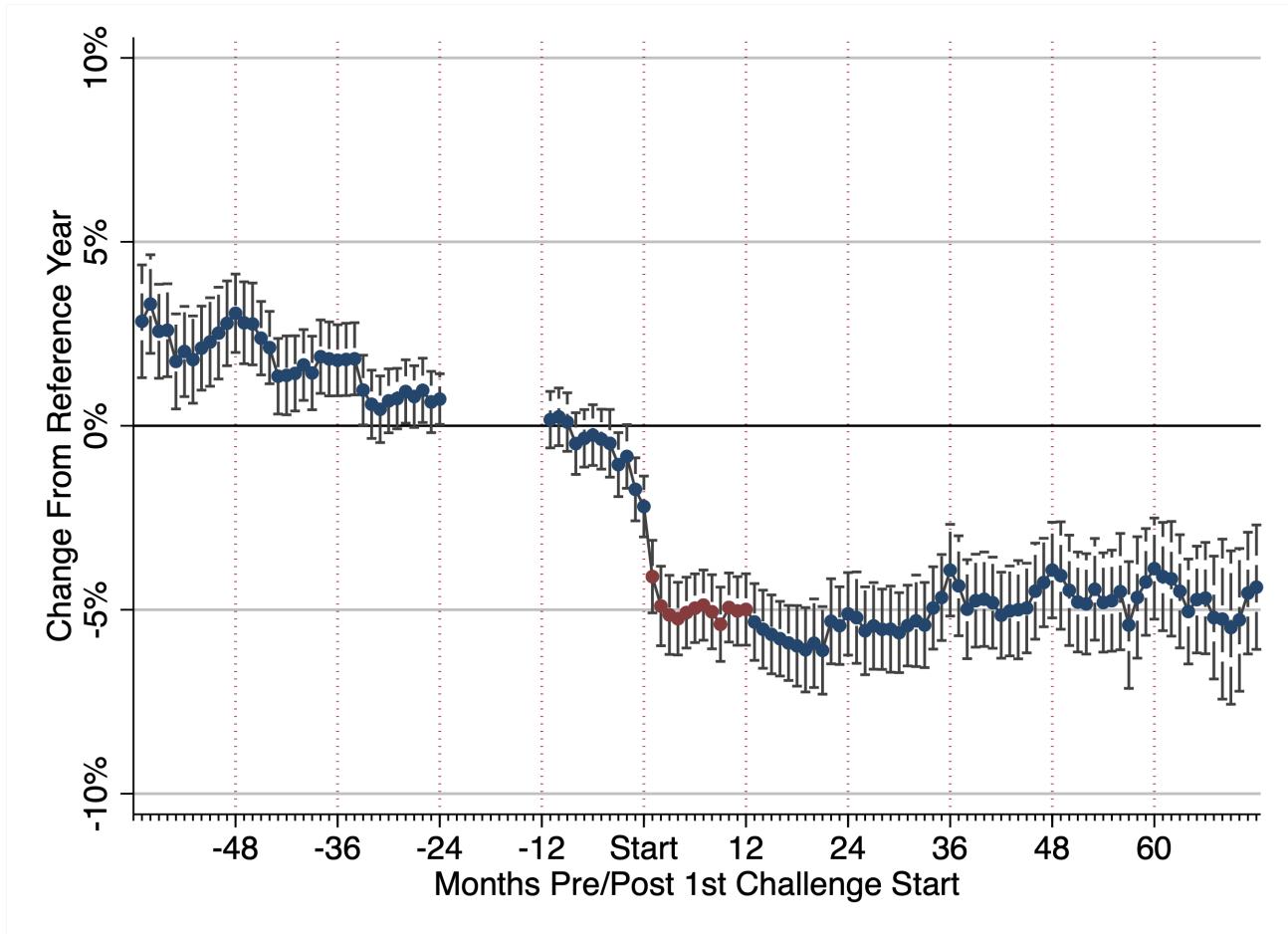
Notes: Estimates include separate month-of-year fixed effects for electric and non-electric heating households.

Figure B.10: Date-heating-building type time trend



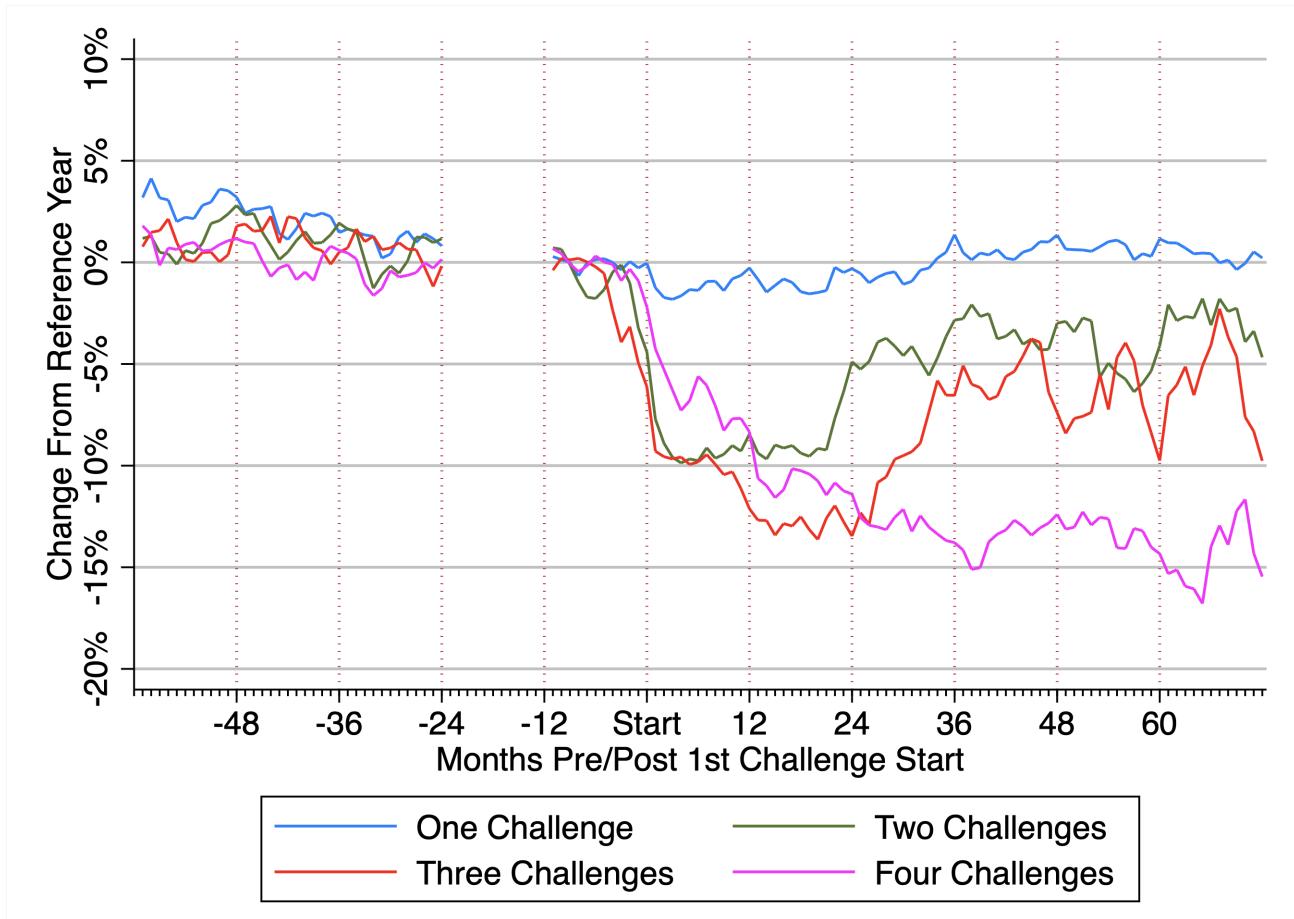
Notes: Estimates include separate month-of-year fixed effects for each building and heating type to allow time trends to differ across these categories.

Figure B.11: Two-way clustering by date-household



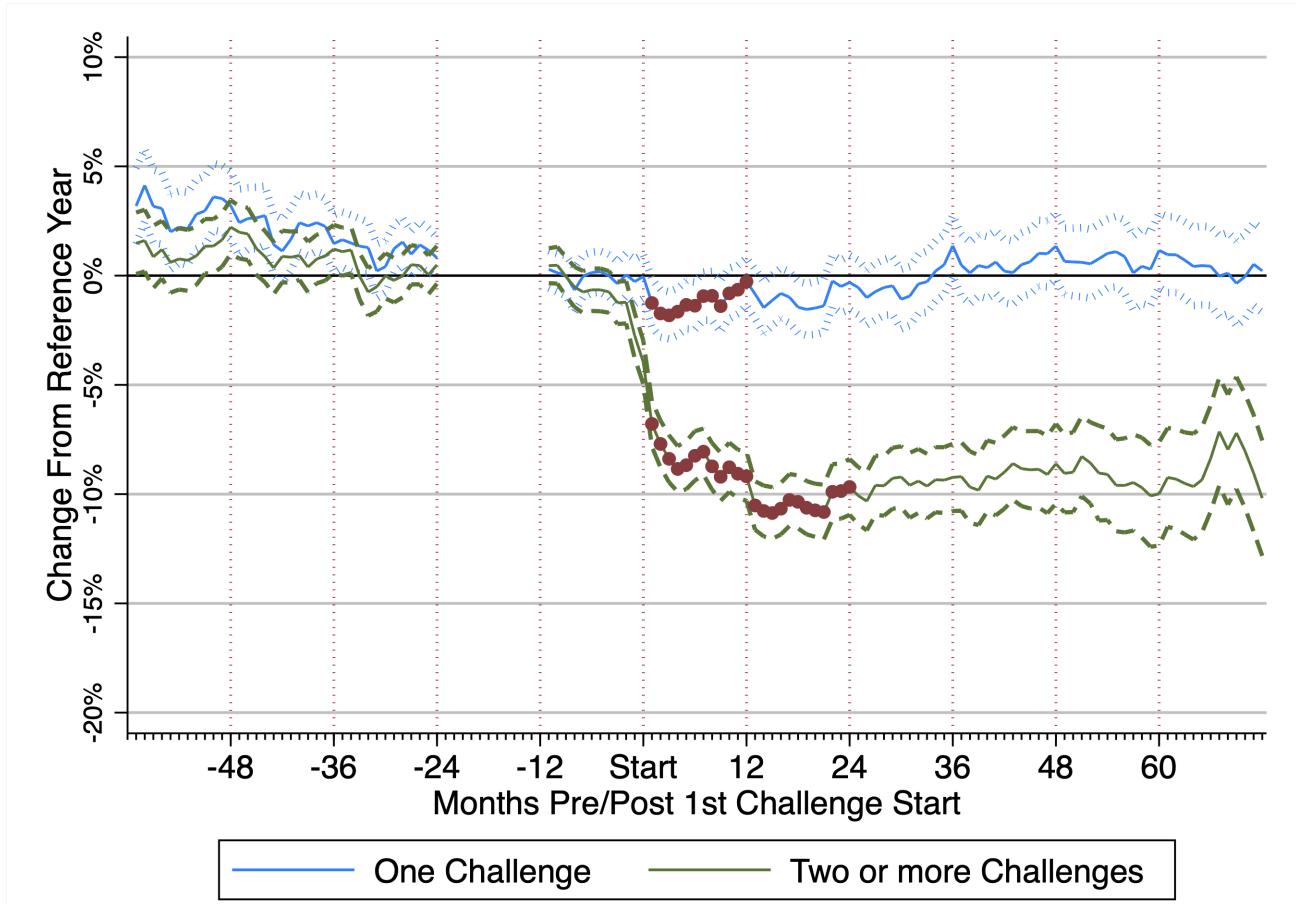
Notes: Estimates with errors clustered by date (month-of-year)-household.

Figure B.12: Overlapping Challenges



Notes: Estimates of $\hat{\beta}_\tau$ for mutually exclusive groups of participant households depending on how many challenges they undertake. This repeats the estimates in Figure 1 excluding confidence intervals for clarity.

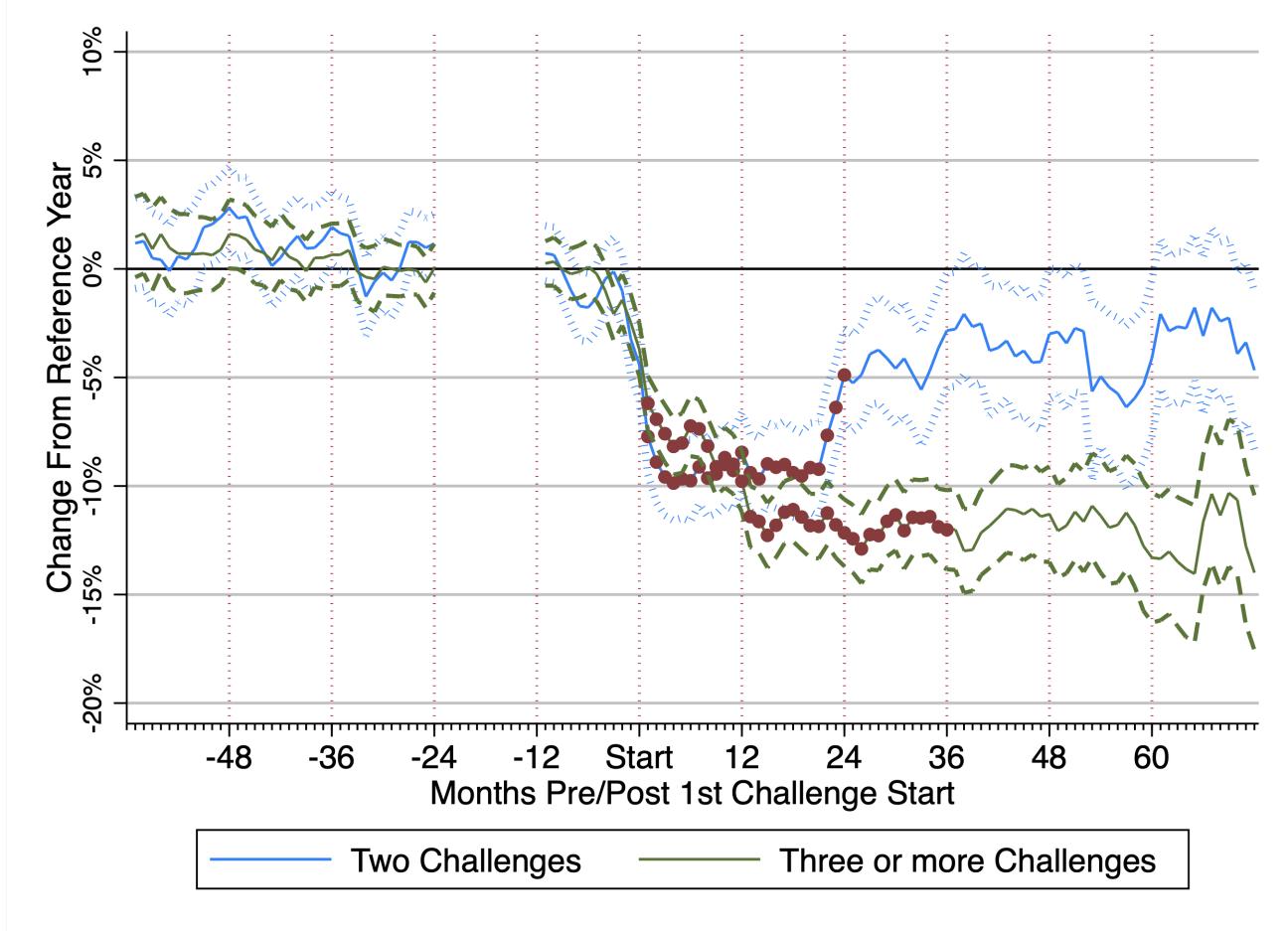
Figure B.13: Single Challenge vs Two Or More Challenges



Notes: This figure plots estimates $\hat{\beta}_\tau$ and 95% confidence intervals from equation (2) estimated for two mutually exclusive groups of households.

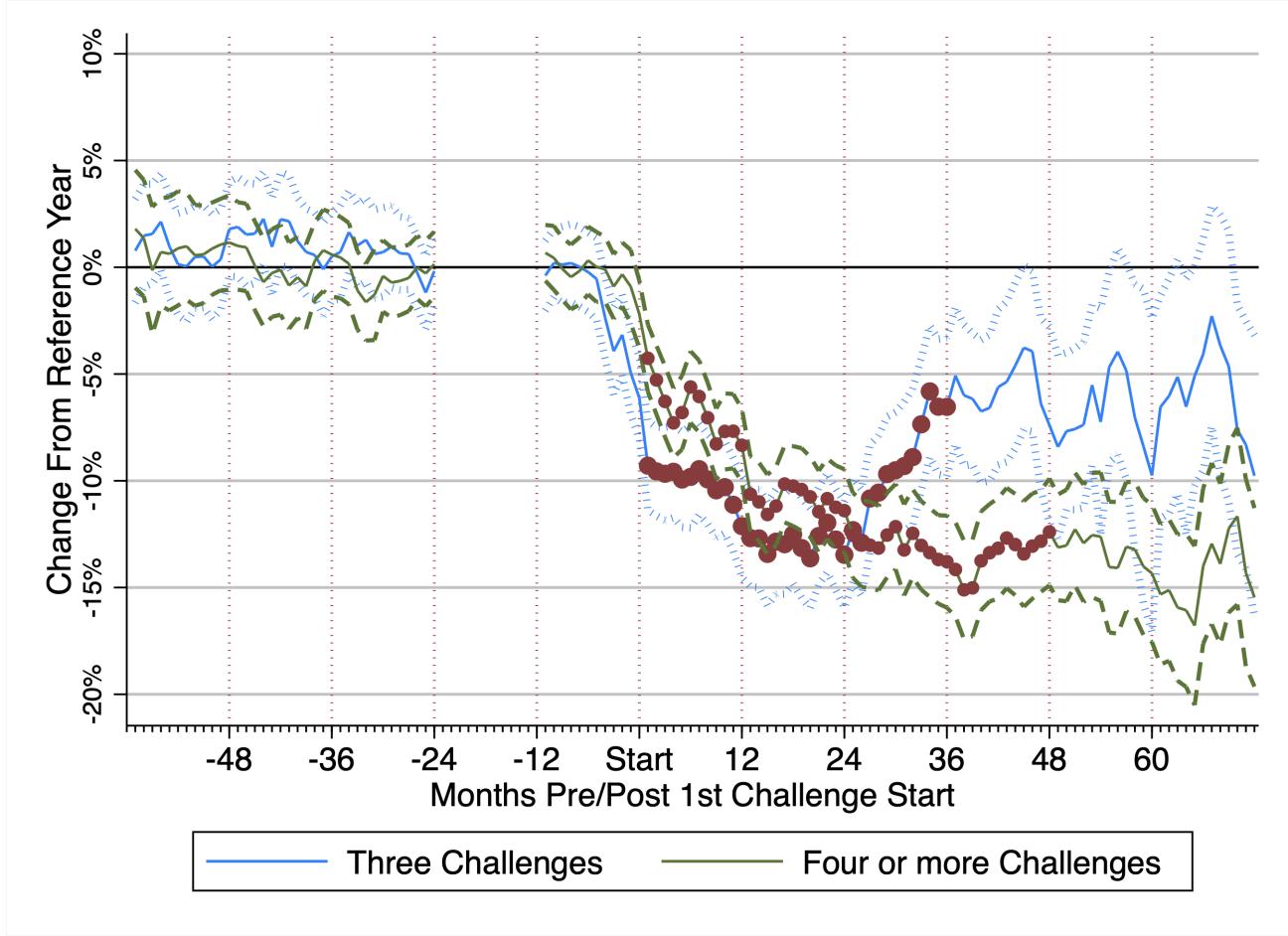
Estimates in blue are households that undertake a single challenge prior to September 2014, and then end their program participation. Event study estimates in green are for households that undertake at least two conservation challenges, both prior to September 2014, and continued to their second challenge within 12 months of completing their initial challenge. Not shown are estimates θ_g for electricity use during the gap between the first and second challenges. Months 13-24 are estimates of the average change in electricity use among households in their second conservation challenge independent of any gap between challenges. Estimates include individual and date fixed effects and I cluster standard errors at the household level.

Figure B.14: Two Challenges vs Three Or More Challenges



Notes: This figure plots estimates $\hat{\beta}_\tau$ and 95% confidence intervals from equation (2) estimated for two mutually exclusive groups of households. Estimates in blue are households that undertook two conservation challenges prior to September 2014, and end their participation after a second conservation challenge. Estimates in green are households that continue to a third conservation challenge, all undertaken prior to September 2014. Estimation sample restricted to households that continue to subsequent challenges within 12 months. Not shown are estimates θ_g for electricity use during the gap between challenges. Estimates include individual and date fixed effects and I cluster standard errors at the household level.

Figure B.15: Three Challenges vs Four Or More Challenges



Notes: This figure plots estimates $\hat{\beta}_\tau$ and 95% confidence intervals from equation (2) estimated for two mutually exclusive groups of households. Estimates in blue are households that undertook three conservation challenges prior to September 2014, and end their participation after the third conservation challenge. Estimates in green are households that continue to a fourth conservation challenge, with all four challenges undertaken prior to September 2014. Estimation sample restricted to households that continue to subsequent challenges within 12 months. Not shown are estimates θ_g for electricity use during the gap between challenges. Estimates include individual and date fixed effects and I cluster standard errors at the household level.

B.3 Estimates by Heating Type

Electricity conservation may vary by season depending on how households reduce their electricity use. Improved insulation, smart thermostats, or reductions in the household temperature will produce larger energy savings in the winter and among households that heat primarily with electricity. More efficient dryers, lightbulbs, or other changes that affect primarily non-seasonal electricity use will generate energy savings year round for both household heating types. Comparing when during the year that reductions in electricity use occur, and between household heating types, sheds light on how households have responded to the conservation challenge. To explore this I estimate equation (1) separately for each calendar month and household heating type. In Figure B.1 (top panel) I plot estimates from the initial year of a challenge separately for each calendar month. This shows both household heating types have similar reductions in percentage terms in the summer months, while Electric Space Heating households have larger reductions in the winter months. Figure B.1 (lower panel) also plots event-study estimates separately for Electric and non-Electric heating households; this shows they have similar trends in reductions in electricity use over time and with slightly larger reductions among electric heating households.

To estimate the fraction of energy conservation due to heating I use the average reduction in electricity use over the four warmest summer months as a measure of non-heating related conservation. I extrapolate this to all 12 months, and attribute the remaining conservation as heating-related. Multiplying the percent reductions by the monthly average pre-program use I find 23% of conservation among non-electric heating households and 51% of the conservation among electric heating households is related to heating. That non-electric heating households have reductions due to heating is not unexpected; non-electric heating households may still use some electric heat such as after-market baseboard heaters in addition to their non-electric primary heat source.

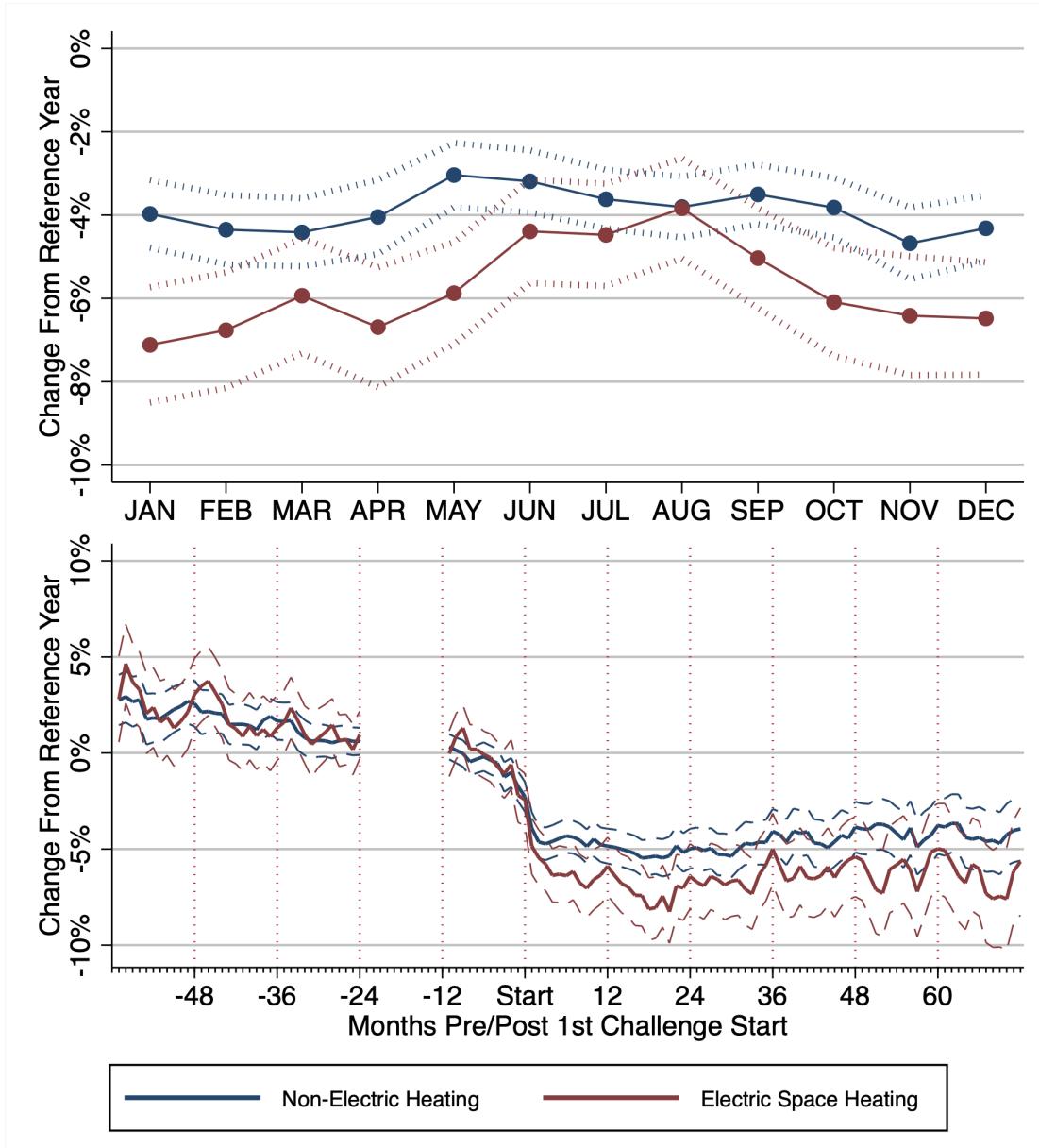
B.4 Estimates by Household Characteristics

To estimate energy conservation across household characteristics I use an annual event study model,

$$y_{it} = \sum_{\gamma=-119}^{108} \theta_\gamma D_{it,\gamma} + \alpha_i + d_t + \epsilon_{it} \quad (2)$$

where y_{it} is log monthly electricity use for household i at month-of-year t , and $D_{it,\gamma}$ is an indicator for if household i in monthly date t is in year γ pre or post the challenge start date. α_i and d_t are household and month-of-year fixed effects. I use the last pre-program year as the reference year. In Table B.1 Panel A I compare quartiles of pre-program (2006) electricity use, in Panel B I compare 1 Story and 2 Story Single Family Dwellings, Apartments, and Townhouses, in Panel C I compare quartiles of Assessed Value which is the combined land and structure value, and in Panel D I compare quartiles of the reported floor space of the house. Comparing point estimates I do not find statistically

Figure B.1: Estimates By Heating Type



Notes: Top panel: estimated electricity use changes during the initial conservation challenge relative to the same calendar month two years prior. Estimates are from equation (1) estimated separately for each month of the year. 95% confidence intervals shown by the dashed lines. Bottom panel: estimates from equation (1) for all participant and non-participant households separately by heating type.

Table B.1: Estimates by Pre-Determined Variables

| Panel A: Quartiles of Pre-Program Electricity Use | | | | |
|---|-------------------------|-------------------------|-------------------------|-------------------------|
| | 1st | 2nd | 3rd | 4th |
| $\theta_1 : Initial\ Challenge$ | -0.0601*** (0.00598) | -0.0375*** (0.00527) | -0.0549*** (0.00500) | -0.0452*** (0.00510) |
| Avg. Use in 2006 (kWh) | 381 | 645 | 934 | 1527 |
| Panel B: Building Type | | | | |
| | 1 Sty SFD | 2 Sty SFD | Apartment | Townhouse |
| $\theta_1 : Initial\ Challenge$ | -0.0477*** (0.00432) | -0.0473*** (0.00486) | -0.0654*** (0.00837) | -0.0505*** (0.00657) |
| # of participants | 3426 | 2421 | 1283 | 1102 |
| Panel C: Quartiles of Assessed Value | | | | |
| | 1st | 2nd | 3rd | 4th |
| $\theta_1 : Initial\ Challenge$ | -0.0536*** (0.00555) | -0.0518*** (0.00496) | -0.0481*** (0.00526) | -0.0452*** (0.00563) |
| Avg. Assessed Value (\$1,000) | \$288 | \$482 | \$686 | \$1,226 |
| Panel D: Quartiles of Floor Area | | | | |
| | 1st | 2nd | 3rd | 4th |
| $\theta_1 : Initial\ Challenge$ | -0.0577*** (0.00592) | -0.0549*** (0.00518) | -0.0400*** (0.00535) | -0.0474*** (0.00542) |
| Avg. Floor Area (sq. ft.) | 984 | 1638 | 2192 | 3254 |

Notes: Panel A: Quartiles of pre-program electricity use determined from households' average electricity use in the pre-program year 2006. Quartiles are defined separately for the balanced set of participant and non-participant households. Panel B: Building type includes the four principal housing types of single story single family dwellings, two story single family dwellings, apartments, and town homes. Panel C: quartiles of assessed value are from the 2010 BC Assessment for individual units and include both structure and land value. Panel D: Quartiles of unit floor area. Estimates are the average change in electricity use during the initial challenge relative to the 2nd year pre-program. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

significant differences at the 5% level. If higher assessed value in Panel C is taken as a proxy for income, the results imply that households respond similarly across quartiles of wealth.

Appendix C Cost Effectiveness

The Team Power Smart program is designed to produce electricity generation capacity savings and reduce the expected future increase in demand for electricity. A full welfare analysis of the TPS program is beyond the scope of this work. Instead, I provide a lower bound on the cost of avoided electricity generation caused by the program. I estimate a lower bound for two reasons. First, because the costs of administering and advertising the Team Power Smart reward program are confidential to BC Hydro, I consider only the cost of the \$75 rebates rewarded to households, and leave aside the costs of administering the program.¹ Second, I make the assumption that the estimated electricity conservation

¹Because the program is administered online, variable costs excluding the rebate are likely to be negligible. Program fixed costs may not be insignificant relative to the cost of the rewarded rebates. One full time equivalent employee

from the event study model are fully causal treatment effects; any overestimate of the true treatment effect will bias upward the cost of avoided generation. From the estimated electricity conservation and the average electricity use among participants, Table 1, I find that the average aggregate reduction in electricity use over the first six years after an initial challenge is 2.7 MWh per household. This is the average across all households and accounts for their decisions whether to re-enroll after each challenge. Taking into account households' average success in their conservation challenges, and the number continuing to additional challenges, the average aggregate rebate payment over the six years is \$53 per household. This finds an average cost of avoided generation of \$20/MWh. In comparison, participants paid an average retail price of \$96/MWh in 2016, while a large hydroelectric dam under construction in the province is estimated to have a levelized cost of electricity of \$34-\$83/MWh (British Columbia Utilities Commission, 2017). This makes the Team Power Smart program a cost-effective way to reduce the demand for electricity in comparison to the cost of new generation.

What is the cost of avoided carbon emissions due to this energy conservation program? It is important to note that this energy conservation program was not designed to principally reduce carbon emissions and the cost of avoided emissions is not particularly relevant to BC Hydro. British Columbia generates over 90% of its electricity from hydroelectric dams and has a low emissions intensity of 9kgCO2e/MWh (BCH, 2016); \$20 per avoided MWh is a cost of avoided greenhouse gas emissions of \$2,222/tCO2eq. However, BC Hydro engages in large cross-border trade in electricity with the United States, primarily California. Lower electricity use in British Columbia allows BC Hydro to sell relatively low cost and low emissions power to California. Assuming all reductions in B.C. electricity use reduces generation in California finds, using the 2017 California average emissions intensity (EPA, 2017), a cost of emissions abatement of \$71/tCO2. At the 2017 U.S. average emission intensity, this falls to \$45/tCO2 (Schivley, Azevedo, and Samaras, 2018). These abatement costs are within the range of commonly discussed estimates of the SCC (EPA, 2016), and indicate that in some jurisdictions, repeated financial reward programs similar to the one studied in this work may be cost effective relative to the SCC. The results of this paper show that the continued incentive of repeated financial rewards is important for maintaining and causing additional reductions in electricity use. The continued incentive improves the program's cost-effectiveness, compared to a program offering a single annual conservation challenge. This improved cost-effectiveness occurs for two reasons. First, the program administration fixed costs are spread across additional conservation challenges. Second, the repeated incentive causes additional reductions, and keeps electricity use from rebounding back close to pre-program levels.

Appendix D The Re-enrollment Decision

All households that participate in Team Power Smart have the option of re-enrolling in additional conservation challenges. To explore what correlates with households' decisions to re-enroll in a second challenge I estimate Probit models of equation (3). C_i is a binary indicator for if a household re-enrolls in

compensated at \$70,000 per year for managing the program would add approximately \$6 per challenge to the program. This is \$20 per awarded rebate using the 30% success rate over the initial five challenges households undertake.

a second conservation challenge. X_i is a vector of household characteristics, R_i are changes in electricity use households' received credit for during the first challenge, $1\{R_i \leq \bar{R}\}$ is a dummy variable equal to one if a household was successful in the initial challenge by achieving reductions R_i less than the $\bar{R} = -9.5$ threshold, and P_i is a household's pre-program use measured in standard deviations from the mean of households' 2006 electricity use within heating and building type categories.

$$C_i = \beta \mathbf{X}_i + \theta R_i + \gamma_1 1\{R_i \leq \bar{R}\} + \gamma_2 P_i + \epsilon_i \quad (3)$$

Table D.1 shows the marginal effects from estimating equation (3) with the indicated covariates. Specification (1) includes households' electric heating category and building type. I use the most common household type, Single Story Single Family Dwellings that heat primarily without electricity, as the reference category; marginal effects show the change in probability of re-enrolling relative to this household type. Specification (1) shows Townhouses are the only household type with a statistically significant, at the 5% level, difference (4.76%) in the probability of re-enrolling. This is consistent with the findings from Subsection B.3 that electricity conservation is higher for Townhomes compared to other household types. Specification (2) shows that the probability of re-enrolling does not materially differ across the number of bedrooms, household value, or size of the house. Specification (3) shows that households with larger electricity conservation are more likely to re-enroll while Specification (4) demonstrates this is through the channel of passing their conservation challenge. The large magnitude of the coefficient on Success highlights its importance in re-enrollment compared to differences across household characteristics. Taking the largest difference in point estimates across household characteristics in Specification (4) finds Townhouses are 8.6% more likely to re-enroll than homes classified Other. In comparison, households that pass their conservation Challenge are 20.2% more likely to re-enroll. Specification (5) includes a household's Pre-Program use measured in standard deviations from the mean of households' 2006 electricity use, measured within heating and building type categories. This shows that households with higher Pre-Program electricity use are more likely to re-enroll; households three standard deviations above the mean 2006 electricity use are 5.9% more likely to re-enroll. However, this magnitude is not large compared to the effect of Success — Specification (6) — or differences between Townhomes and Other.

Figure D.1 plots the probability of continuing to a second conservation challenge against the reductions in billed—not credited—electricity use from that household's first challenge. Larger reductions in billed electricity use are associated with a greater likelihood of continuing to a subsequent challenge. Figure D.1 also shows the fraction of households succeeding in their challenge. From this we can see some households with reductions greater than 9.5% do not pass their challenge, while other households with reductions less than 9.5% do pass. This occurs because success or failure in a challenge is evaluated from changes in weather-adjusted—not billed—electricity use.

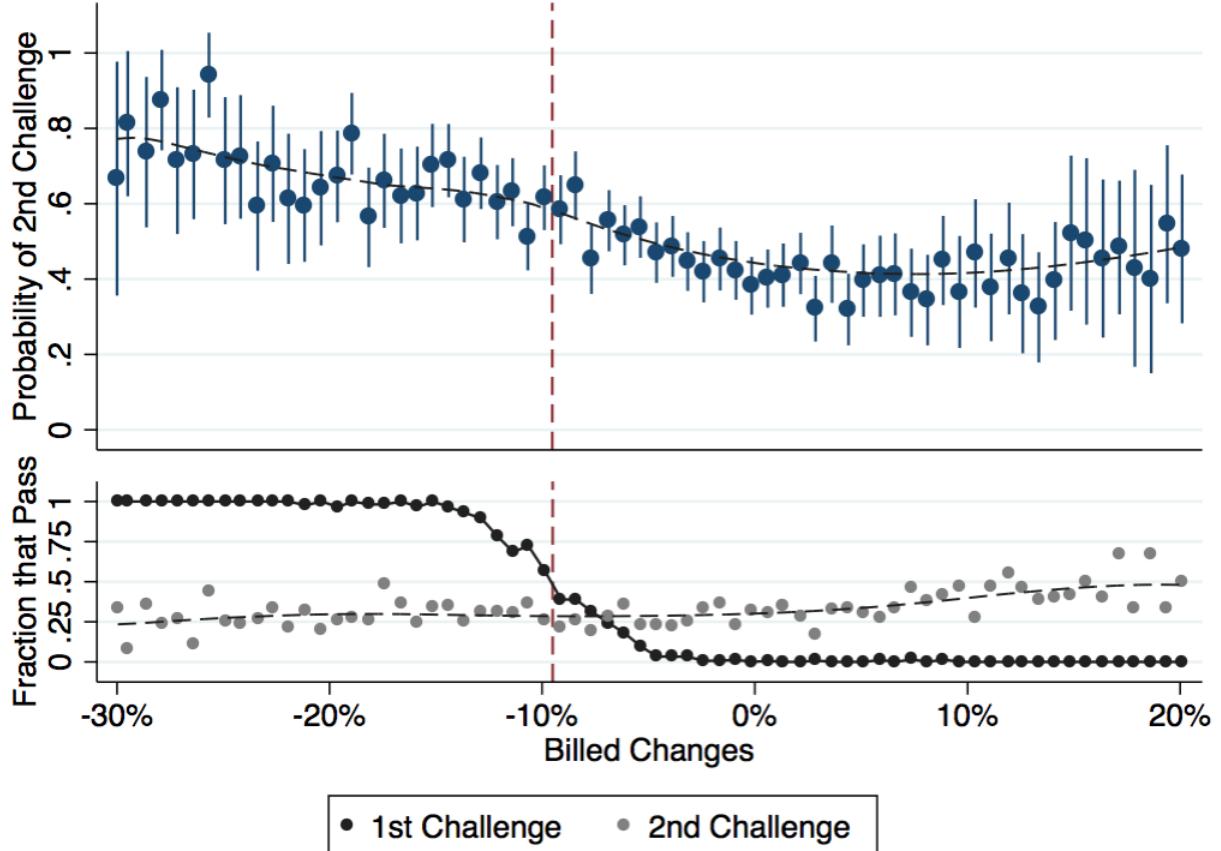
Table D.2 shows the marginal effects from estimating equation 3 for the decision to re-enroll in a third conservation challenge. These results are broadly consistent with those for a second challenge, Table D.1, and differ in two ways. First, households are more likely to re-enroll in a third challenge if they

Table D.1: Probit Model: Re-Enrolling in a Second Challenge

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|----------------------|----------------------|-----------------------|-----------------------|-------------------------|-------------------------|
| Dependent variable: Re-enrollment in a second conservation challenge | | | | | | |
| Non-Electric Heat | - | - | - | - | - | - |
| Electric Heat | 0.00339 (0.0148) | 0.000862 (0.0152) | 0.00618 (0.0130) | -0.00700 (0.0150) | 0.00307 (0.0149) | -0.00716 (0.0151) |
| Heating Unknown | -0.0140 (0.0178) | -0.00329 (0.0185) | -0.0179 (0.0156) | -0.00725 (0.0178) | -0.0133 (0.0178) | -0.00645 (0.0178) |
| 2 Story Sfd | -0.00917 (0.0147) | 0.00850 (0.0160) | -0.00523 (0.0128) | -0.00684 (0.0149) | -0.00938 (0.0147) | -0.00710 (0.0149) |
| 1 Story Sfd | - | - | - | - | - | - |
| 1.5 Story Sfd | -0.0160 (0.0294) | 0.000639 (0.0301) | 0.00412 (0.0261) | -0.0191 (0.0297) | -0.0161 (0.0294) | -0.0194 (0.0298) |
| Apartment | 0.00729 (0.0199) | -0.0434* (0.0263) | 0.00968 (0.0176) | 0.00845 (0.0201) | 0.00815 (0.0200) | 0.00920 (0.0202) |
| Townhouse | 0.0476** (0.0187) | 0.0217 (0.0206) | 0.0484*** (0.0166) | 0.0570*** (0.0187) | 0.0477** (0.0187) | 0.0573*** (0.0187) |
| Other (home type) | -0.0361 (0.0350) | -0.0500 (0.0360) | 0.00270 (0.0302) | -0.0294 (0.0350) | -0.0362 (0.0351) | -0.0294 (0.0350) |
| Bedrooms | | -0.0117 (0.00739) | | | | |
| Value | | -0.0195 (0.0132) | | | | |
| Floor Area | | -0.0257 (0.0239) | | | | |
| Cred. Changes: R_i | | | -0.270*** (0.0420) | 0.0221 (0.0357) | | |
| Success: $1\{R_i \leq \bar{R}\}$ | | | | 0.203*** (0.0138) | | 0.200*** (0.0114) |
| Pre-Program Use: P_i | | | | | -0.0194*** (0.00567) | -0.0235*** (0.00570) |
| Households | 7181 | 6879 | 9818 | 7181 | 7180 | 7180 |
| Pseudo R^2 | 0.001 | 0.003 | 0.009 | 0.030 | 0.003 | 0.031 |
| χ^2 | 12.915 | 23.406 | 58.206 | 274.263 | 24.541 | 288.702 |

Notes: This table shows how differences in household characteristics are correlated with the probability of re-enrolling in a second conservation challenge. These are estimated using a Probit model with dependent variable an indicator $C_i = 1$ if household i re-enrolls, $C_i = 0$ if household i does not re-enroll. Estimates are relative to the reference category of One Story Single Family Dwellings that are primarily non-electric heating. Value and Floor area are natural logs, Credited Changes is the percent change in Challenge 1 electricity conservation credited to households, and Success an indicator equal to 1 if a household achieves their Challenge 1 conservation target. Pre-program use is the number of standard deviations between a household's electricity use in 2006 and the average electricity use among households within the same building and heating type category. All coefficients are marginal effects at the covariate means. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Figure D.1: Probability of Continuing to a Second Challenge: Billed Electricity Use



Notes: Billed changes are the percent change in billed electricity consumption from the pre-program year to the year of the first conservation challenge. The -9.5% level is shown by the vertical dashed line - note this is not the threshold for success as success was defined from credited - not billed - changes. Point estimates in the top bottom panel are the average probability of continuing to a second conservation challenge within 0.75%-wide bins of billed changes from the first conservation challenge. The dashed line in the top panel shows separate 1st order polynomial fits to households with billed changes above and below the indicated -9.5% threshold.

The bottom panel shows the corresponding fraction who pass their initial reduction challenge (dark connected line) and subsequent challenge (light grey scatter plot.) The dashed grey line in the bottom panel is a 3rd order kernel-weighted local polynomial fit to the fraction of households that pass their second conservation challenge.

use electric heating whereas townhomes are no-longer more likely to re-enroll. Second, magnitude of passing the second challenge is smaller — 12.3% in Specification (4) of Table D.2— compared to the 20.2% magnitude on Success in the initial challenge from Table D.1.

Appendix E Fuzzy Regression Discontinuity Identifying Assumptions

A regression discontinuity strategy requires that units on one side of the threshold that defines treatment are a suitable counterfactual for units on the other (Lee and Lemieux, 2010). This assumption would be violated if households can precisely manipulate their assignment into treatment, and such manipulation results in households sorting at the discontinuity in any way that affects average potential outcomes. Such sorting is a concern in this setup as households are explicitly trying to achieve the 10% conservation target. Sorting could occur if, for example, households are heterogenous in their attention to their progress and high-information type households exert additional effort in the last months of a conservation challenge and self-select into passing their challenge. Fortunately, the separation of the 9.5% threshold (and resulting discontinuity in re-enrollment) for Challenge success from the 10% reduction target allows me to show that this RD strategy remains valid despite households manipulating the running variable of electricity conservation such that they exhibit bunching at the 10% reduction target. As Lee and Lemieux (2010) note, manipulation of the assignment value in itself does not invalidate RD designs. It is discontinuous potential outcomes, caused by households sorting across the assignment value defining treatment and therefore being co-incident with treatment, that can bias RD estimates.

As in standard regression discontinuity models, evidence on whether sorting is likely to have occurred or not can be obtained from understanding the ability of agents to manipulate their assignment, the continuity of observables, and the density of observations across the discontinuity. Sorting discontinuously at the 9.5% threshold for success is unlikely for several reasons. Most importantly, households were not aware that their success or failure would be evaluated against a 9.5% threshold instead of the advertised 10% target. In addition, the weather adjustment mechanically randomizes households near the threshold into and out of treatment based on the weather change that occurred. The cumulative nature of the challenge also makes precise manipulation of success difficult. For example, a household at a 9% cumulative reduction entering the last month of their challenge would have to double their previous monthly reductions and reduce their use in the last month by 21% to achieve their aggregate 10% target. To test for discontinuities I estimate equation 3 for several bandwidths and find no statistically significant discontinuity in observables at the 9.5% threshold — Table E.1 and Figure E.3. The lack of sorting is further supported by a McCrary (2008) density test shown in Figure E.4, which fails to reject the null hypothesis (one sided p-value 0.117) of no discontinuity in the density of the running variable at the 9.5% threshold.

However, a lack of sorting at the 9.5% threshold would not remove the potential problem of sorting across the 10% target. This is because in practice the estimation bandwidth around the 9.5% discontinuity needs to also span the 10% target to obtain a suitably large sample size. Applying the McCrary

Table D.2: Probit Model: Re-Enrolling in a Third Challenge

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|-----------------------|-----------------------|-----------------------|----------------------|-----------------------|-----------------------|
| Dependent variable: Re-enrollment in a third conservation challenge | | | | | | |
| Non-ElectricHeat | - | - | - | - | - | - |
| Electric Heat | 0.0545*** (0.0179) | 0.0423** (0.0185) | 0.0279 (0.0170) | 0.0449** (0.0181) | 0.0545*** (0.0179) | 0.0446** (0.0181) |
| Heating Unknown | 0.0326 (0.0218) | 0.0409* (0.0225) | 0.0265 (0.0207) | 0.0347 (0.0217) | 0.0325 (0.0219) | 0.0345 (0.0217) |
| 1 Story Sfd | - | - | - | - | - | - |
| 2 Story Sfd | -0.0120 (0.0181) | 0.00136 (0.0195) | -0.0169 (0.0170) | -0.0134 (0.0182) | -0.0119 (0.0181) | -0.0132 (0.0181) |
| 1.5 Story Sfd | 0.00146 (0.0357) | 0.0174 (0.0359) | 0.00157 (0.0342) | -0.00220 (0.0361) | 0.00175 (0.0357) | -0.00219 (0.0361) |
| Apartment | -0.0134 (0.0248) | -0.0608* (0.0331) | -0.0171 (0.0232) | -0.0157 (0.0250) | -0.0133 (0.0248) | -0.0161 (0.0250) |
| Townhouse | 0.00196 (0.0227) | -0.0217 (0.0251) | 0.0172 (0.0213) | 0.00556 (0.0226) | 0.00209 (0.0227) | 0.00584 (0.0225) |
| Other (home type) | 0.0714* (0.0401) | 0.0579 (0.0419) | 0.00951 (0.0396) | 0.0760* (0.0394) | 0.0717* (0.0399) | 0.0770* (0.0393) |
| Bedrooms | | -0.00281 (0.00913) | | | | |
| Value | | -0.0212 (0.0162) | | | | |
| Floor Area | | -0.0462 (0.0294) | | | | |
| Cred. Changes: R_i | | | -0.296*** (0.0446) | -0.0517 (0.0467) | | |
| Success: $1\{R_i \leq \bar{R}\}$ | | | | 0.123*** (0.0173) | | 0.135*** (0.0142) |
| Pre-Program Use: P_i | | | | | -0.00586 (0.00692) | -0.00976 (0.00693) |
| Households | 4489 | 4311 | 5638 | 4489 | 4489 | 4489 |
| Pseudo R^2 | 0.003 | 0.004 | 0.008 | 0.017 | 0.003 | 0.018 |
| χ^2 | 14.943 | 22.165 | 50.910 | 95.478 | 15.844 | 96.236 |

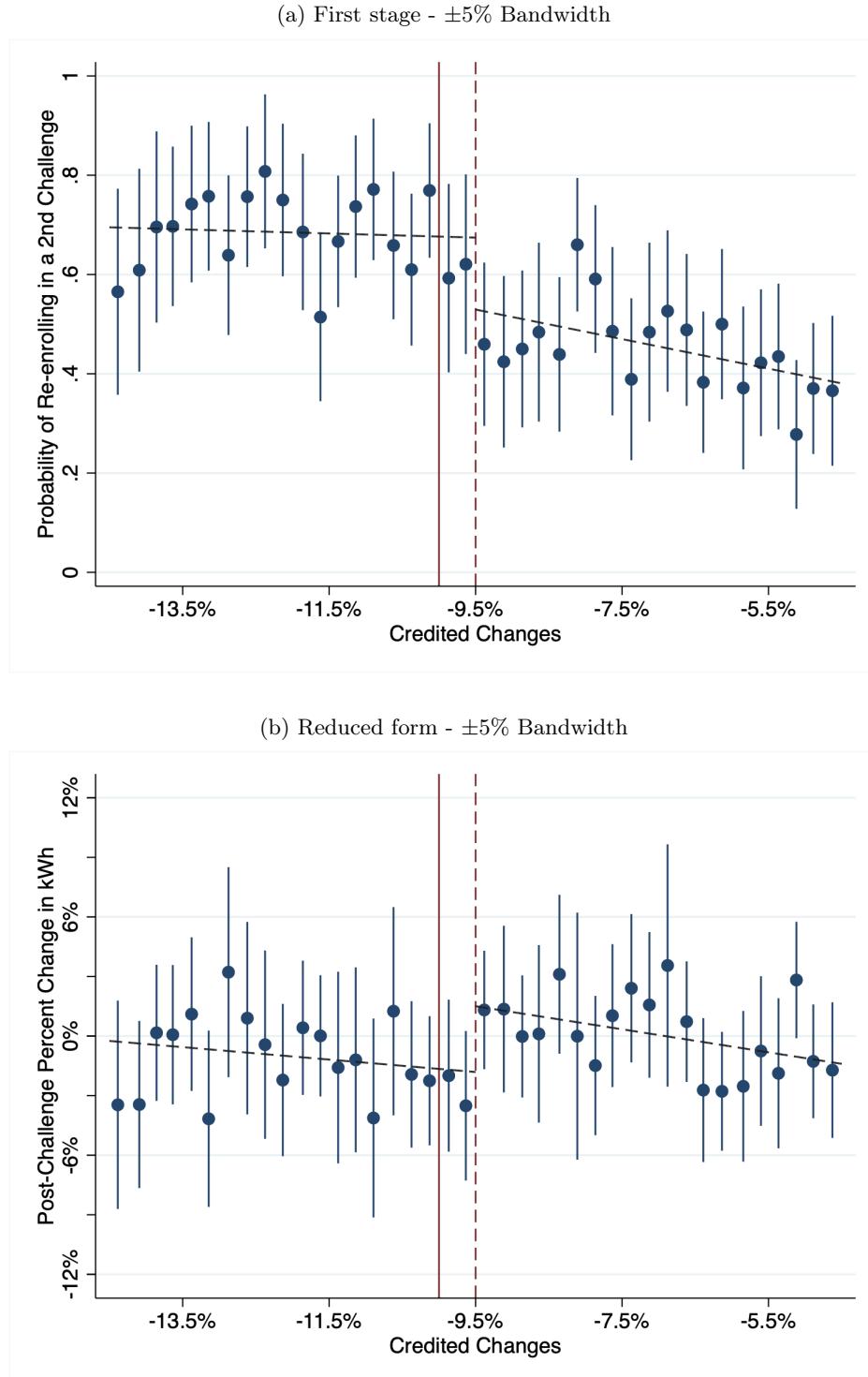
Notes: This table shows how differences in household characteristics are correlated with the probability of re-enrolling in a third conservation challenge. Estimates are relative to the reference category of One Story Single Family Dwellings that are primarily non-electric heating. Value and Floor area are in natural logs, Credited Changes is the percent change in Challenge 2 electricity conservation credited to households, and Success an indicator equal to 1 if a household achieves their second challenge conservation target. Pre-program use is the number of standard deviations between a household's electricity use in 2006 and the average electricity use among households within the same building and heating type category. All coefficients are marginal effects at the covariate means. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

(2008) density test in Figure E.5 at the 10% target — not the 9.5% threshold — rejects that there is no discontinuity in the density (one sided p-value 0.0017.) This suggests households can manipulate their assignment around the 10% target, despite the difficulty of precise manipulation discussed above.

Such manipulation only invalidates the RD strategy if it causes discontinuous potential outcomes. I find no statistically significant discontinuity in observables at the 10% target, suggesting that sorting correlated with observables is not occurring. The typical concern would be that sorting at the 10% target on unobservables, which affect outcomes, could still occur. However, BC Hydro's separation of the 10% target from the 9.5% threshold allows the continuity of the outcome variables — and the underlying continuity of unobservables — at the 10% target to be directly tested. If households were sorting around the 10% target in a way that affects potential outcomes, this would appear as a discontinuity at the 10% threshold in either the probability of continuing in the program or in subsequent electricity conservation. Figure E.1 (a) plots the probability that households re-enroll in a second conservation challenge by their credited changes in the first challenge; corresponding to the preferred 5% bandwidths estimated in Table 3. The solid vertical line shows the 10% target, and the dashed vertical shows the 9.5% threshold for success or failure. Importantly, the discontinuity in the probability of re-enrolling occurs at the 9.5% threshold for determining success or failure, and not at the 10% target that households are trying to achieve. Figure E.1 (b) plots y_i from equation 5 against the same bins of credited changes during a households' first conservation challenge. The discontinuity occurs again at the 9.5% threshold, not 10% conservation target. That these outcomes change discontinuously only at the 9.5% threshold— and not the 10% target—shows that households are not sorting in a manner that affects potential outcomes. The same discontinuities using a 9% bandwidth are shown in Figure E.2.

Along with the continuity of observables, the continuity of outcomes suggests that households are not sorting at the 10% target despite bunching. As a result, I conclude the discontinuity in Figure 2 is due to households succeeding in their conservation challenge and deciding to re-enroll, and is not due to manipulation of their electricity conservation that results in sorting around the 9.5% threshold or 10% target. In addition, the lack of sorting around the 10% target correlated with observables or correlated with unobservables that affect the outcome allows RD estimation bandwidths be used that span the 10% target.

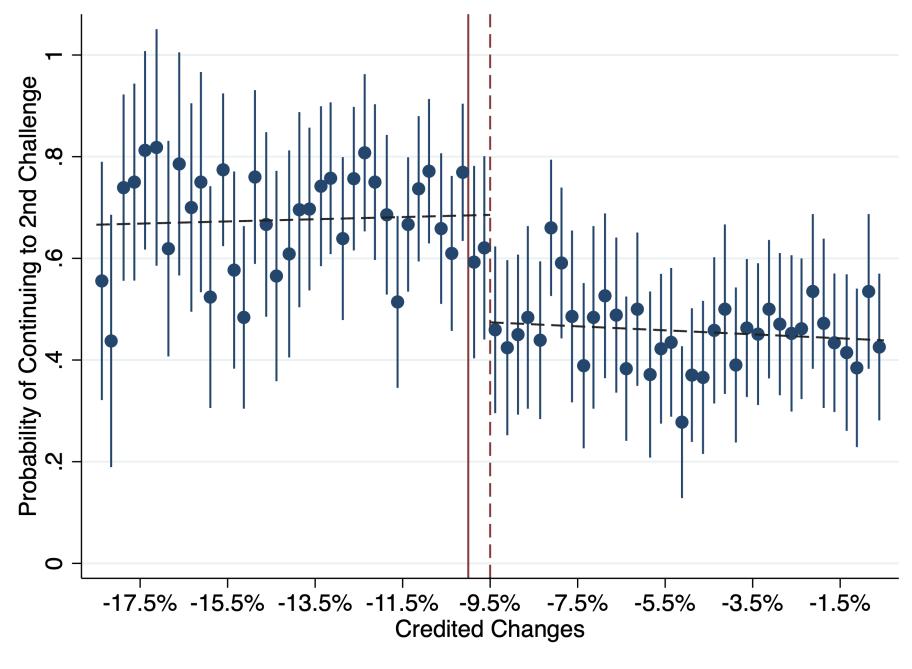
Figure E.1: Re-enrollment in a second challenge: first stage and reduced form discontinuities



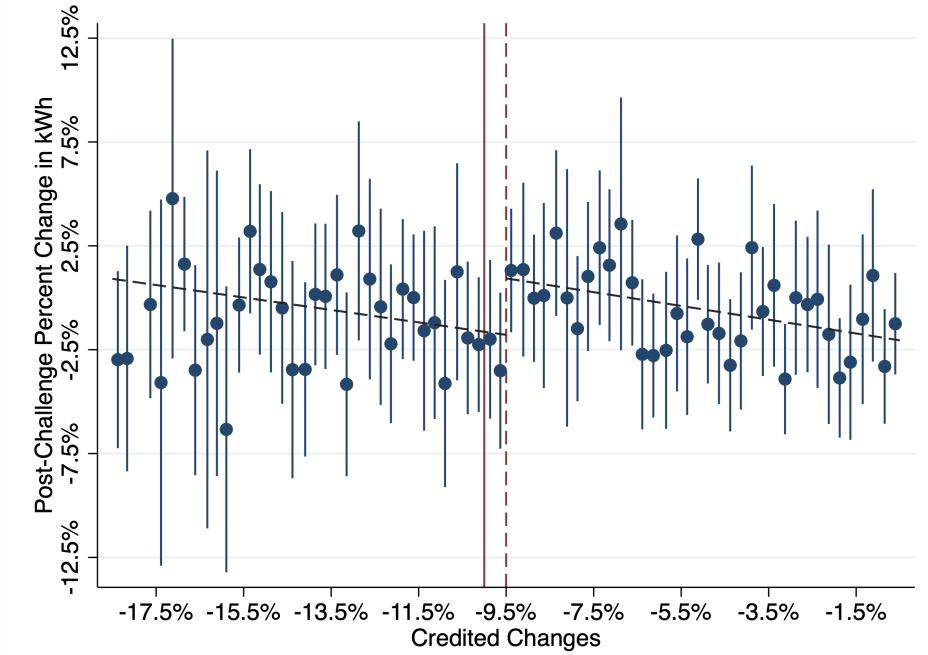
Notes: The solid vertical line is at the 10% conservation target and the dashed vertical line denotes the 9.5% threshold for success in a Challenge. Panel (a) shows the Probability of Re-enrolling as defined in Figure 2. In panel (b) the Post-Challenge Percent Change in kWh denotes the percentage annual change in electricity use from the year of the conservation to the post-challenge year.

Figure E.2: First Stage and Reduced Form Discontinuities

(a) First Stage - $\pm 9\%$ Bandwidth

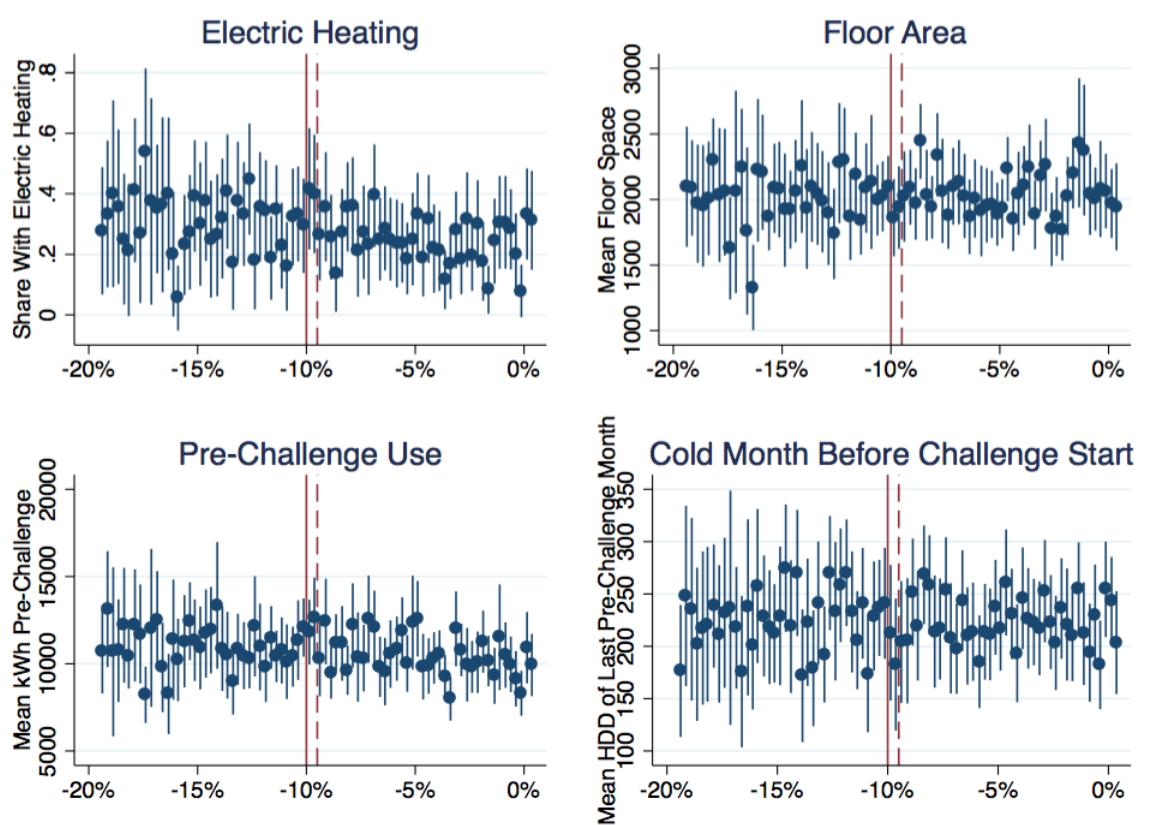


(b) Reduced Form - $\pm 9\%$ Bandwidth



Notes: This figure plots the first stage and reduced form discontinuities for a 9% bandwidth around the 9.5% reduction threshold in credited changes. Individual point estimates are the average of the outcome variable within 0.25% width bins in credited changes.

Figure E.3: Continuity of Covariates at The Discontinuity



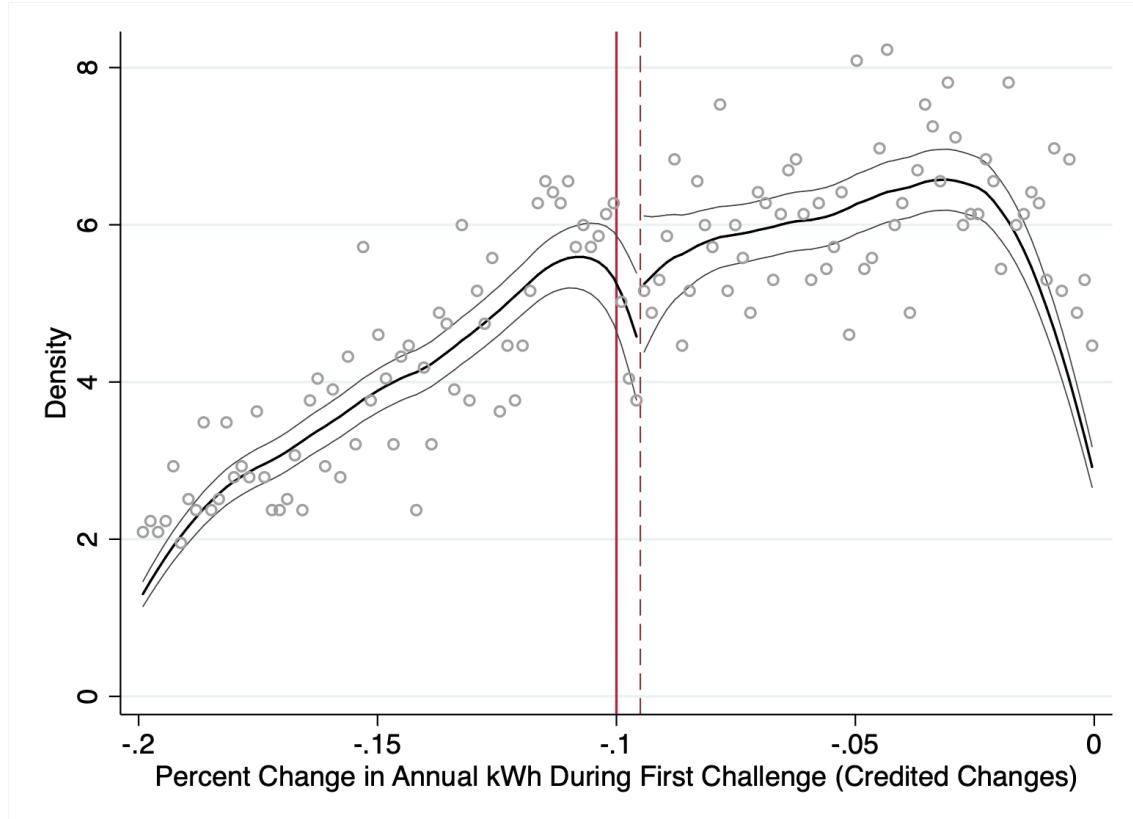
Notes: Averages of four example covariates in the vicinity of the discontinuity by 0.25% wide bins of credited changes. *Electric Heating* is the share of households with electric space heating. *Floor Area* is the average floor space of a household. *Pre-Challenge Use* is the average electricity use in the year before a household begins its first challenge. *Cold Month Before Challenge Start* is the average heating degree days in the last month prior to the initial challenge. This is a measure of the last weather shock prior to the initial participation decision. The x-axis shows reductions in credited use with the dashed red vertical line denoting the 9.5% threshold for success and the solid red vertical line denoting the 10% conservation target.

Table E.1: Discontinuity tests of covariates at the 9.5% discontinuity

| Dependent Variable: | Window Size | | | | |
|---------------------|-----------------------|-----------------------|----------------------|---------------------|----------------------|
| | 3 | 4 | 5 | 6 | 7 |
| Heating | 0.089 (0.076) | 0.036 (0.065) | 0.022 (0.058) | 0.004 (0.053) | 0.037 (0.049) |
| Floor Area | -168.672 (129.915) | -118.697 (111.300) | -110.062 (99.744) | -61.026 (91.517) | -27.826 (85.809) |
| Pre-Program kWh | 1155.694 (853.864) | 1126.179 (720.725) | 673.470 (663.070) | 71.468 (589.560) | 198.537 (552.341) |
| Pre-Program HDD | -23.74 (23.32) | -18.97 (19.74) | -6.499 (17.53) | -4.555 (15.82) | -2.678 (14.67) |
| Property Value | -48.510 (68.793) | -30.153 (62.081) | 5.379 (54.773) | 34.891 (51.611) | 54.255 (47.112) |
| Share SFD | -0.065 (0.078) | -0.022 (0.067) | -0.042 (0.060) | -0.052 (0.054) | -0.012 (0.050) |

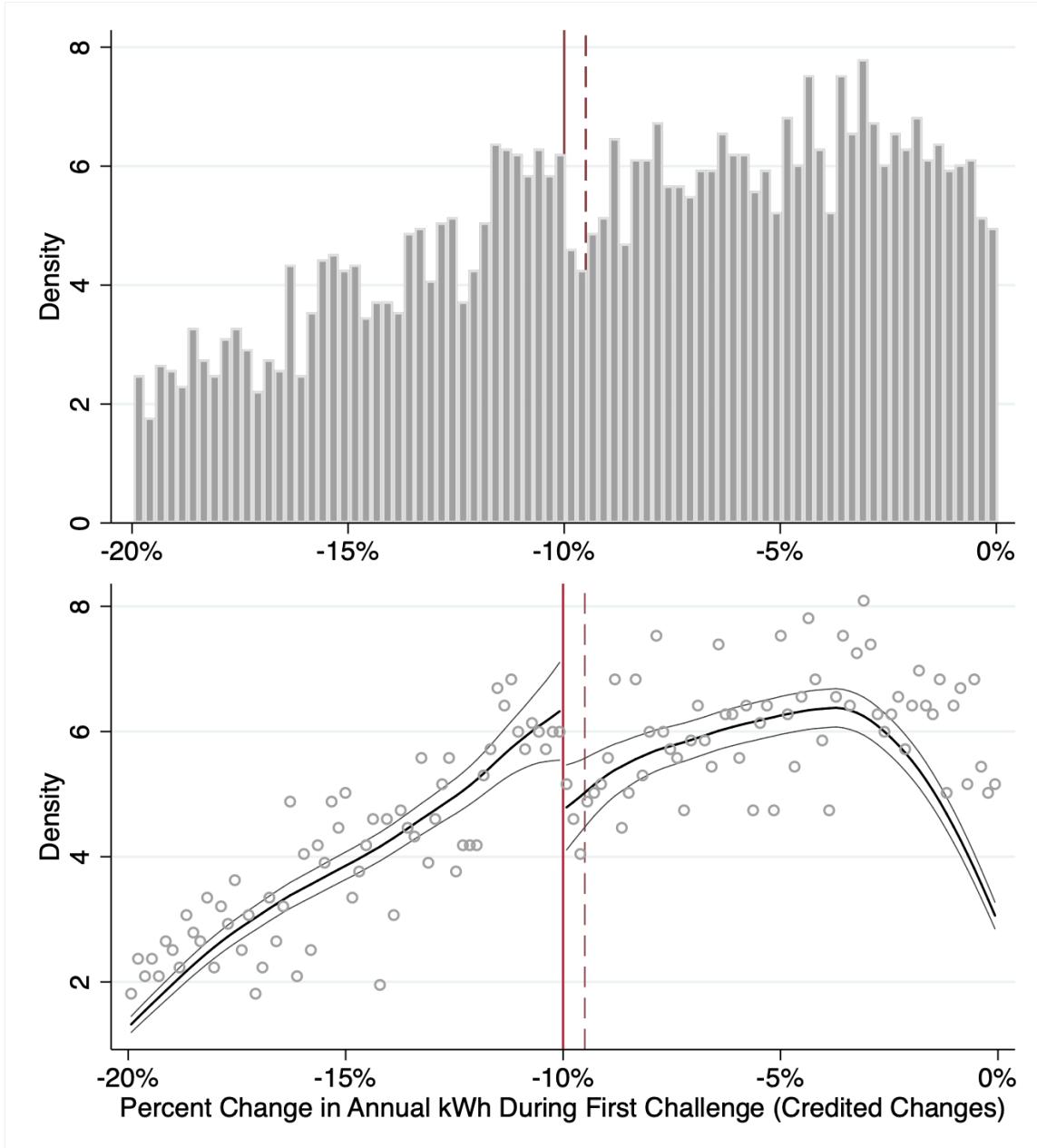
Notes: The table shows regression discontinuity estimates of γ_1 estimated using equation 3 for the listed dependent variables at the 9.5% threshold. The lack of statistically significant differences in covariates at the discontinuity supports that treatment is as good as randomly assigned at the discontinuity. Estimates included separate linear trends billed reductions and are not shown for conciseness. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1 are listed for completeness but no coefficients are significant at a 10% level.

Figure E.4: Density Test of the Running Variable - 9.5% Threshold



Notes: McCrary (2008) density test of the percent change in electricity use from a household's initial conservation challenge. The dark line is a smoothed local linear fit to the density of changes in electricity use, with 95% confidence intervals indicated by the light grey line. Point estimates of the density are grey circles. The dashed red line is the 9.5% reduction threshold, and the solid line is the 10% reduction target.

Figure E.5: Density Test of the Running Variable

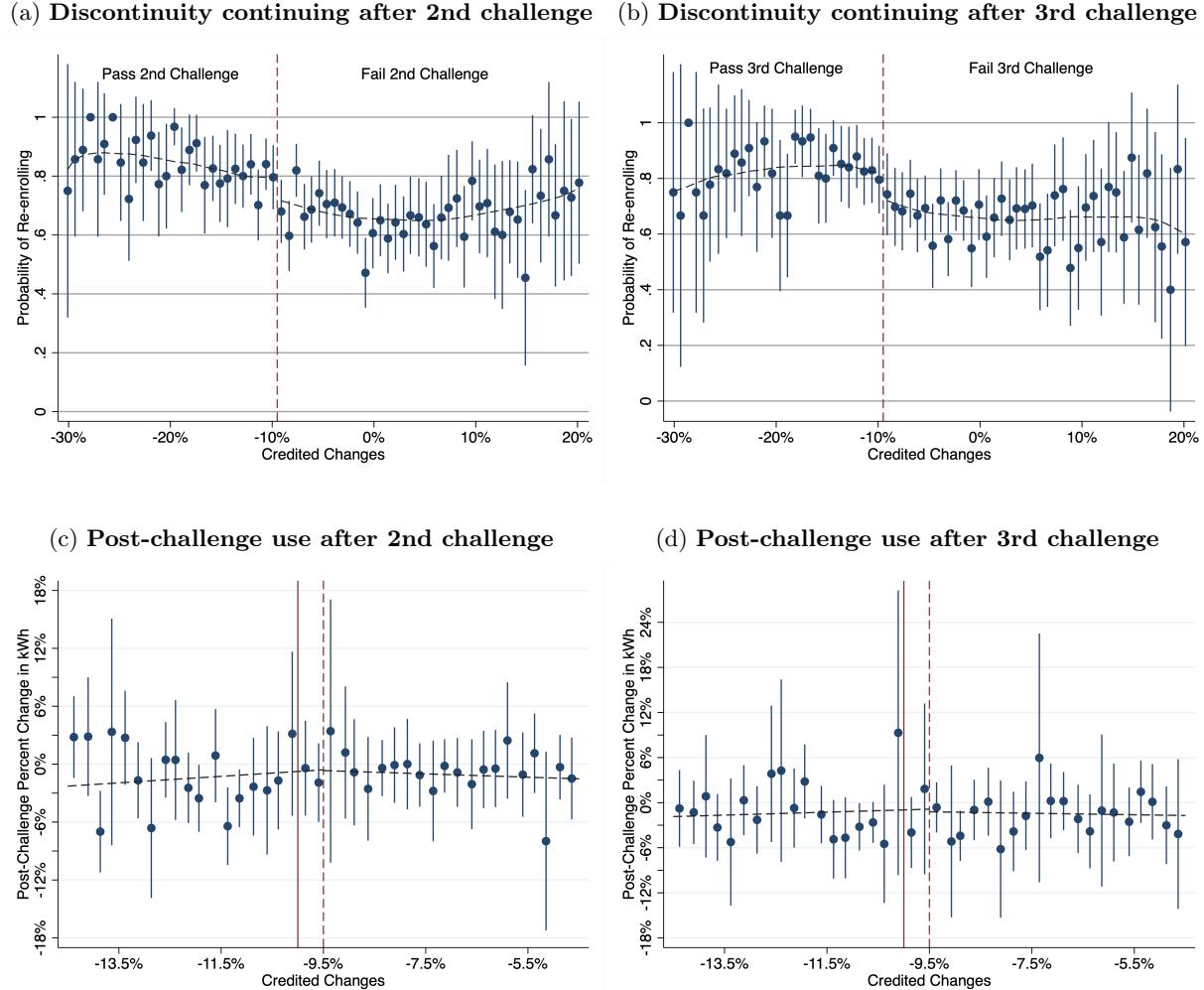


Notes: The dashed red line is the 9.5% reduction threshold, and the solid line is the 10% reduction target. Histogram of households' credited changes during their initial conservation challenge. The increase in mass to the left of the vertical line demonstrates the potential for bunching at the 10% target. McCrary (2008) density test of the percent change in electricity use from a household's initial conservation challenge. The dark line is a smoothed local linear fit to the density of changes in electricity use, with 95% confidence intervals indicated by the light grey line. Point estimates of the density are grey circles.

Appendix F Discontinuities for Challenges 2 and 3

Figure F.1 shows the discontinuities in re-enrolling after a 2nd and 3rd challenge and the potential discontinuity in post-challenge electricity use. Post-challenge electricity use is calculated as the percentage change in electricity use from a household's 2nd (3rd) conservation challenge to the following 12 months if a household does not re-enroll, and to the following 12 months of a challenge if a household does re-enroll.

Figure F.1: Discontinuities for the 2nd and 3rd challenges



Notes: Credited changes are weather-adjusted changes in electricity use as displayed to households. The vertical dashed line indicates the 9.5% threshold defining success; households to the left of the dashed line pass their conservation challenge while those to the right fail. Panel (a) and (b) point estimates are the mean probability of re-enrolling with 95% confidence intervals among households within 0.75% width bins in credited changes. The dashed line is a first order local polynomial fit; this is to clarify the local trends and is not the fuzzy RD fit. Panels (c) and (d) show point estimates and 95% confidence intervals of the mean change in billed electricity use in the first year after the initial conservation goal estimated for 0.75% width bins.

Appendix G Fuzzy-Regression Discontinuity Robustness Checks

An identifying assumption of a fuzzy RD estimation strategy is that households just on either side of the discontinuity are as good as randomly assigned. Evidence that this assumption does not hold would be if the IV estimates were sensitive to the inclusion of additional covariates. Table G.1 shows IV estimates controlling for detailed household characteristics and changes in heating degree days. I control for the percent change in heating degree days between both the pre-program and first conservation challenge years ($HDD_{0,1}$) and between the first conservation challenge and post-challenge year ($HDD_{1,2}$). Increases in heating degree days during the post-challenge period are positively correlated with post-challenge changes in electricity use. This is consistent with colder weather increasing the demand for electricity. The inclusion of these additional covariates has only a small effect on the estimated effect of a second conservation challenge and supports the identifying assumption that households are as good as randomly assigned at the discontinuity.

A potential concern with the weather adjustment is if households with the same credited changes differ substantially in billed changes in the vicinity of the discontinuity. If billed reductions affect the post-program outcomes, for example if households were to exhibit a strong reversion to the mean, then outliers in the weather adjustment could cause a violation of the good-as-randomly assigned assumption. Evidence that this is not a problem is gained by further restricting the estimation sample to households that had billed changes within $\pm 5\%$ of 9.5% in billed reductions. This excludes those households receiving large weather adjustments to their billed electricity use, in addition to the estimation bandwidth in credited reductions. Estimates, Table G.2, are robust to this restriction.

A potential concern with RD estimates is that the using observations away from the threshold increases the risk of biased estimates (Calonico, Cattaneo, and Titiunik, 2014). In Table G.3 and Table G.4 I present bias-corrected estimates using 1st and 2nd order polynomial fits and the method of Calonico, Cattaneo, and Titiunik (2014). Specification (8) presents the optimal bandwidth of 10% determined from the variance-bias tradeoff.

Table G.5 uses an alternate limit to the gap between challenges, limiting the estimation sample to households that re-enroll within 6 months of completing their initial challenge.

G.1 Robustness Checks - Log monthly electricity use

An alternative to defining the outcome in the fuzzy-RD approach as the post-program percent changes in electricity use, equation (5), is using log monthly electricity use. This has the benefit of not requiring aggregation to annual changes at the cost of a less transparent estimation; I find using log monthly electricity use results in similar estimates for the causal effect of re-enrolling as the primary fuzzy RD estimates of equation (5).

The first stage relationship is

$$C_i = \alpha_i + \gamma_0 D_{it,1} + \gamma_1 \mathbb{1}\{R_i \leq \bar{R}\} \times D_{it,1} + \gamma_2 R_i \times D_{it,1} + \gamma_3 \mathbb{1}\{R_i \leq \bar{R}\} \times R_i \times D_{it,1} + \eta_{it} \quad (4)$$

Table G.1: Fuzzy Regression Discontinuity Estimates: Additional Covariates

| | (2) | (3) | (4) | (5) | (6) |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| Panel A – First Stage | | | | | |
| Dependent variable: Continue to a Second Challenge C_i | | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| γ_1 : Success Ind. | 0.199*** (0.0432) | 0.187*** (0.0468) | 0.135*** (0.0516) | 0.130** (0.0571) | 0.151** (0.0676) |
| γ_2 : Cred. Reduc. | -0.0921 (0.849) | -0.969 (1.037) | -2.199* (1.297) | -0.274 (1.817) | 2.316 (2.777) |
| γ_3 : Success × Cred. Reduc. | 1.141 (1.107) | 2.443* (1.385) | 2.525 (1.803) | -1.094 (2.428) | -3.451 (3.878) |
| γ_4 : Billed Reduc. | -0.745 (0.457) | -0.778 (0.485) | -0.892* (0.510) | -1.202** (0.533) | -1.514** (0.699) |
| $HDD_{0,1}$ | -0.287 (0.229) | -0.260 (0.244) | -0.594** (0.265) | -0.642** (0.284) | -0.725** (0.349) |
| γ_0 : Constant | 0.463*** (0.0340) | 0.476*** (0.0370) | 0.505*** (0.0405) | 0.480*** (0.0454) | 0.465*** (0.0529) |
| F-statistic | 21.18 | 15.87 | 6.889 | 5.146 | 4.969 |
| Panel B – Second Stage | | | | | |
| Dependent variable: Percent change in post-challenge electricity use | | | | | |
| Instrumental Variable Estimates | | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| β_1 : Re-Enroll | -0.127** (0.0620) | -0.181** (0.0755) | -0.248* (0.129) | -0.341* (0.179) | -0.209 (0.137) |
| β_2 : Cred. Reduc. | -0.389 (0.245) | -0.581* (0.347) | -1.028 (0.626) | -0.807 (0.767) | 0.882 (0.690) |
| β_3 : Success × Cred. Reduc. | 0.344 (0.313) | 0.417 (0.431) | 0.932 (0.654) | -0.286 (1.028) | -1.724 (1.300) |
| β_4 : Billed Reduc. | -0.101 (0.142) | -0.205 (0.161) | -0.358* (0.206) | -0.552* (0.314) | -0.439 (0.316) |
| $HDD_{0,1}$ | -0.0434 (0.0699) | -0.0663 (0.0804) | -0.189 (0.123) | -0.239 (0.171) | -0.154 (0.161) |
| β_0 : Constant | 0.0786** (0.0353) | 0.108** (0.0437) | 0.151** (0.0744) | 0.196** (0.0984) | 0.118 (0.0744) |
| N | 2049 | 1763 | 1475 | 1196 | 888 |

Notes: This table reports fuzzy-RD estimates corresponding to equations (3) and (4). All specifications include building type and heating category fixed effects. $HDD_{0,1}$ and $HDD_{1,2}$ are, respectively, the percent change in heating degree days from the pre-program year to the initial challenge, and initial challenge to the post-program year. Estimation sample restricted to households that either start their next challenge within 12 months or do not undertake an additional challenge. Estimation window is restricted to ± the listed percent around the 9.5% threshold in credited changes. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table G.2: **Fuzzy Regression Discontinuity Estimates: Restricted Billing**

| | (3) | (4) | (5) | (6) | (7) |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|
| Panel A – First Stage | | | | | |
| Dependent variable: Continue to a Second Challenge C_i | | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| γ_1 : Success Ind. | 0.184*** (0.0485) | 0.181*** (0.0516) | 0.121** (0.0561) | 0.121** (0.0614) | 0.172** (0.0721) |
| γ_2 : Cred. Reduc. | 0.0618 (1.018) | -0.0825 (1.205) | -2.105 (1.476) | -1.072 (2.003) | 3.004 (3.073) |
| γ_3 : Success \times Cred. Reduc. | -0.633 (1.414) | -0.292 (1.679) | 0.0330 (2.104) | -1.981 (2.740) | -5.156 (4.291) |
| γ_4 : Billed Reduc. | 0.173 (0.612) | 0.0615 (0.625) | 0.215 (0.643) | 0.283 (0.691) | -0.163 (0.762) |
| γ_0 : Constant | 0.477*** (0.0349) | 0.482*** (0.0371) | 0.515*** (0.0401) | 0.500*** (0.0444) | 0.458*** (0.0511) |
| F-stat | 14.36 | 12.34 | 4.649 | 3.889 | 5.665 |
| Panel B – Second Stage | | | | | |
| Dependent variable: Percent change in post-challenge electricity use | | | | | |
| Instrumental Variable Estimates | | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| β_1 : Re-Enroll | -0.174** (0.0791) | -0.191** (0.0848) | -0.269* (0.159) | -0.307 (0.188) | -0.118 (0.103) |
| β_2 : Cred. Reduc. | -0.531* (0.312) | -0.638* (0.355) | -1.240* (0.733) | -1.118 (0.876) | 0.953 (0.631) |
| β_3 : Success \times Cred. Reduc. | -0.133 (0.442) | -0.00562 (0.487) | 0.319 (0.719) | -0.386 (1.132) | -1.527 (1.204) |
| β_4 : Billed Reduc. | 0.282 (0.191) | 0.203 (0.194) | 0.238 (0.238) | 0.252 (0.279) | 0.0407 (0.212) |
| β_0 : Constant | 0.0902** (0.0454) | 0.102** (0.0490) | 0.150 (0.0916) | 0.166 (0.106) | 0.0524 (0.0564) |
| N | 1393 | 1291 | 1147 | 982 | 763 |

Notes: Sample restricted to households with billed changes within ±5% of the 9.5% conservation target along with restricting households to those within the listed estimation window around the 9.5% threshold in credited reductions. Estimation sample restricted to households that either start their next challenge within 12 months or do not undertake an additional challenge.

Table G.3: 1st Order Bias-Corrected Fuzzy Regression Discontinuity Estimates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|-----------------|-----------|----------|----------|----------|-----------|-----------|-----------|-----------|
| Conventional | -0.188* | -0.235** | -0.259** | -0.236** | -0.199** | -0.171** | -0.163** | -0.150** |
| | (0.105) | (0.118) | (0.127) | (0.107) | (0.0853) | (0.0723) | (0.0665) | (0.0613) |
| Bias-corrected | -0.283*** | -0.175 | -0.192 | -0.263** | -0.295*** | -0.289*** | -0.254*** | -0.169*** |
| | (0.105) | (0.118) | (0.127) | (0.107) | (0.0853) | (0.0724) | (0.0665) | (0.0613) |
| Robust | -0.283* | -0.175 | -0.192 | -0.263* | -0.295** | -0.289*** | -0.254*** | -0.169** |
| | (0.158) | (0.176) | (0.187) | (0.155) | (0.121) | (0.102) | (0.0931) | (0.0707) |
| Observations | 888 | 1196 | 1475 | 1763 | 2050 | 2296 | 2543 | 2538 |
| Order Poly. (p) | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Order Bias (q) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| BW Poly. (h) | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 10% |
| BW Bias (b) | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 18% |

Notes: This table reports fuzzy-RD estimates using the method of (Calonico, Cattaneo, and Titiunik, 2014). All specifications use 1st order local polynomial regressions using a triangular kernel and restricted to households that either start their next challenge within 12 months or do not undertake an additional challenge. Specifications (1) through (7) are for bandwidths BW Poly. (h) around the threshold. Specification (8) determines the optimal polynomial and bias-correction bandwidths to be 10% and 18%, respectively. The bias correction is 2nd order, local polynomial. Standard errors in parentheses. Conventional and Bias-corrected have conventional standard errors, Robust estimates use robust standard errors. *** p<0.01, ** p<0.05, * p<0.1.

Table G.4: 2nd Order Bias-Corrected Fuzzy Regression Discontinuity Estimates

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|----------------|----------|----------|---------|---------|---------|---------|----------|----------|
| Conventional | -0.281 | -0.189 | -0.211* | -0.264* | -0.319* | -0.331* | -0.281* | -0.181** |
| | (0.199) | (0.125) | (0.123) | (0.156) | (0.192) | (0.193) | (0.153) | (0.0794) |
| Bias-corrected | -0.421** | -0.315** | -0.207* | -0.149 | -0.133 | -0.216 | -0.323** | -0.196** |
| | (0.199) | (0.125) | (0.123) | (0.156) | (0.192) | (0.193) | (0.153) | (0.0794) |
| Robust | -0.421 | -0.315* | -0.207 | -0.149 | -0.133 | -0.216 | -0.323 | -0.196** |
| | (0.264) | (0.168) | (0.166) | (0.210) | (0.259) | (0.257) | (0.201) | (0.0848) |
| Observations | 888 | 1196 | 1475 | 1763 | 2050 | 2296 | 2543 | 4160 |
| OrderPoly.(p) | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| OrderBias(q) | 3 | 3 | 3 | 3 | 3 | 3 | 3 | 3 |
| BWPoly.(h) | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 18% |
| BWBias(b) | 3% | 4% | 5% | 6% | 7% | 8% | 9% | 33% |

Notes: All specifications are a 2nd order polynomial estimated with a triangular kernel and restricted to households that either start their next challenge within 12 months or do not undertake an additional challenge. Specifications (1) through (7) are for \pm the listed bandwidths around the threshold. Specification (8) determines the optimal polynomial and bias-correction bandwidths to be 18% and 33%, respectively. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table G.5: **Fuzzy Regression Discontinuity Estimates: 6 Month Gap**

| | (3) | (4) | (5) | (6) | (7) |
|---|---------------------------------|----------------------|----------------------|----------------------|----------------------|
| Panel A – First Stage | | | | | |
| Dependent variable: Continue to a Second Challenge C_i | | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| γ_1 : Success Indicator | 0.202*** (0.0468) | 0.195*** (0.0505) | 0.161*** (0.0556) | 0.163*** (0.0622) | 0.170** (0.0727) |
| γ_2 : Cred. Reduc. | -0.825 (0.822) | -1.480 (1.016) | -2.573** (1.282) | -0.510 (1.818) | 1.794 (2.876) |
| γ_3 : Success × Cred. Reduc. | 1.897 (1.204) | 3.156** (1.491) | 2.909 (1.959) | -0.527 (2.689) | -3.965 (4.183) |
| γ_4 : Billed Reduc. | -0.568* (0.344) | -0.678* (0.367) | -0.367 (0.391) | -0.649 (0.433) | -0.867* (0.520) |
| γ_0 : Constant | 0.436*** (0.0317) | 0.453*** (0.0344) | 0.466*** (0.0377) | 0.440*** (0.0424) | 0.419*** (0.0495) |
| F-stat | 18.62 | 14.85 | 8.374 | 6.872 | 5.452 |
| Panel B – Second Stage | | | | | |
| Dependent variable: Percent change in post-challenge electricity use | | | | | |
| Window | Instrumental Variable Estimates | | | | |
| Window | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| β_1 : Re-Enroll | -0.144** (0.0655) | -0.165** (0.0739) | -0.190* (0.102) | -0.241* (0.124) | -0.162 (0.114) |
| β_2 : Cred. Reduc. | -0.496* (0.275) | -0.580 (0.363) | -0.864 (0.570) | -0.607 (0.642) | 0.940 (0.675) |
| β_3 : Success × Cred. Reduc. | 0.437 (0.339) | 0.544 (0.446) | 0.827 (0.596) | -0.126 (0.905) | -1.758 (1.246) |
| β_4 : Billed Reduc. | -0.118 (0.101) | -0.197* (0.112) | -0.198 (0.122) | -0.325** (0.162) | -0.333* (0.173) |
| β_0 : Constant | 0.0755** (0.0350) | 0.0879** (0.0407) | 0.104* (0.0554) | 0.124* (0.0646) | 0.0731 (0.0571) |
| N | 1778 | 1535 | 1287 | 1039 | 775 |

Notes: This table reports fuzzy-RD estimates corresponding to equations (3) and (4). Estimation sample restricted to households that either start their next challenge within 6 months or do not undertake an additional challenge. Estimation window is restricted to ± the listed percent around the 9.5% threshold in credited changes. Standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.

where C_i is a binary indicator for whether a household continues to a second challenge, R_i are households' credited changes in electricity use from the first challenge, R_d is the threshold for success in the challenge and is -9.5%, $1\{R_i \leq \bar{R}\}$ is the dummy variable for success in the initial challenge, and the instrument excluded from the second stage is $1\{R_i \leq \bar{R}\}$. $D_{it,1}$ is an indicator for if household i in month t is within the 12 months prior to their second challenge if they re-enroll, or is in the 12 months following their initial challenge if they do not re-enroll. These are not necessarily the same months when households delay re-enrolling in a second challenge. $D_{it,1}$ then defines the effect of continuing relative to the average electricity use over the 12 months following the initial challenge for those households that do not re-enroll. I restrict the sample to households undertaking their first conservation challenge or in their first post-program year of a second challenge, or first 12 months after deciding not to re-enroll.

The second-stage relationship is

$$y_{it} = \lambda_i + \beta_0 D_{it,1} + \beta_1 C_i + \beta_2 R_i \times D_{it,1} + \beta_3 1\{R_i \leq \bar{R}\} \times R_i \times D_{it,1} + \epsilon_i \quad (5)$$

where y_{it} is log monthly electricity use. IV estimates are shown in Tables G.7 and G.6.

Table G.6: Fuzzy Regression Discontinuity Estimates: Log Monthly Electricity Use and 12 Month Gap

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|-------------------------|-------------------------|---------------------------------|----------------------|----------------------|----------------------|---------------------|
| Panel A – First Stage | | | | | | | |
| Dependent variable: Continue to a Second Challenge C_i | | | | | | | |
| Window | | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % | |
| $\gamma_1: Success_i$ | | 0.197*** (0.0431) | 0.186*** (0.0467) | 0.139*** (0.0514) | 0.139** (0.0573) | 0.179*** (0.0678) | |
| $\gamma_0: D_{it,1}$ | | 0.472*** (0.0249) | 0.474*** (0.0268) | 0.503*** (0.0295) | 0.516*** (0.0322) | 0.499*** (0.0378) | |
| $\gamma_2: R_i \times D_{it,1}$ | | -0.708 (0.564) | -1.030 (0.703) | -2.173** (0.926) | -2.202* (1.256) | -0.153 (2.001) | |
| $\gamma_3 : 1\{R_i \geq \bar{R}\} \times R_i \times D_{it,1}$ | | 2.291*** (0.690) | 2.771*** (0.879) | 1.933* (1.132) | 2.052 (1.476) | -0.0147 (2.326) | |
| F-stat | | 20.97 | 15.88 | 7.333 | 5.882 | 6.994 | |
| Panel B – Second Stage | | | | | | | |
| Dependent variable: Log monthly electricity use | | | | | | | |
| Window | OLS | | Instrumental Variable Estimates | | | | |
| | | ±5 % | ±7 % | ±6 % | ±5 % | ±4 % | ±3 % |
| $\beta_1: Success_i$ | -0.0222*** (0.00462) | -0.0281*** (0.00768) | -0.141** (0.0678) | -0.180** (0.0808) | -0.223* (0.126) | -0.290* (0.158) | -0.139 (0.107) |
| $\beta_0: D_{it,1}$ | -0.0156*** (0.00302) | -0.00267 (0.00539) | 0.0620 (0.0387) | 0.0847* (0.0459) | 0.110 (0.0723) | 0.154* (0.0927) | 0.0686 (0.0631) |
| $\beta_2: R_i \times D_{it,1}$ | | | -0.399* (0.211) | -0.618** (0.290) | -0.940* (0.555) | -1.488* (0.805) | -0.302 (0.578) |
| $\beta_3 : 1\{R_i \geq \bar{R}\} \times R_i \times D_{it,1}$ | | | 0.681** (0.278) | 0.861** (0.348) | 1.392*** (0.433) | 2.182*** (0.586) | 2.361*** (0.815) |
| N | 130368 | 35400 | 49200 | 42312 | 35400 | 28704 | 21312 |
| Households | | | 2050 | 1763 | 1475 | 1196 | 888 |

Notes: Estimates restricted to households re-enrolling within 12 months of their initial challenge. *** p<0.01, ** p<0.05, * p<0.1.

Table G.7: Fuzzy Regression Discontinuity Estimates: Log Monthly Electricity Use and 6 Month Gap

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|-------------------------|-------------------------|---------------------------------|----------------------|----------------------|----------------------|---------------------|
| Panel A – First Stage | | | | | | | |
| Dependent variable: Continue to a Second Challenge C_i | | | | | | | |
| Window | | $\pm 7\%$ | $\pm 6\%$ | $\pm 5\%$ | $\pm 4\%$ | $\pm 3\%$ | |
| $\gamma_1: Success_i$ | | 0.194*** (0.0464) | 0.188*** (0.0502) | 0.153*** (0.0551) | 0.164*** (0.0617) | 0.177** (0.0724) | |
| $\gamma_0: D_{it,1}$ | | 0.409*** (0.0266) | 0.410*** (0.0285) | 0.435*** (0.0315) | 0.444*** (0.0347) | 0.442*** (0.0399) | |
| $\gamma_2: R_i \times D_{it,1}$ | | -0.928 (0.600) | -1.051 (0.746) | -1.912* (0.981) | -1.686 (1.357) | -0.894 (2.124) | |
| $\gamma_3 : 1\{R_i \geq R_d\} \times R_i \times D_{it,1}$ | | 2.368*** (0.870) | 2.342** (1.124) | 1.427 (1.417) | 2.326 (1.868) | 0.955 (2.905) | |
| F-stat | | 17.42 | 14.00 | 7.675 | 7.068 | 5.991 | |
| Panel B – Second Stage | | | | | | | |
| Dependent variable: Log monthly electricity use | | | | | | | |
| Window | OLS | | Instrumental Variable Estimates | | | | |
| | | $\pm 5\%$ | $\pm 7\%$ | $\pm 6\%$ | $\pm 5\%$ | $\pm 4\%$ | $\pm 3\%$ |
| $\beta_1: Success_i$ | -0.0222*** (0.00462) | -0.0281*** (0.00768) | -0.171** (0.0757) | -0.170** (0.0833) | -0.192* (0.115) | -0.228* (0.127) | -0.125 (0.112) |
| $\beta_0: D_{it,1}$ | -0.0156*** (0.00302) | -0.00267 (0.00539) | 0.0690* (0.0382) | 0.0689* (0.0418) | 0.0821 (0.0587) | 0.104 (0.0668) | 0.0534 (0.0593) |
| $\beta_2: R_i \times D_{it,1}$ | | | -0.523** (0.246) | -0.538* (0.299) | -0.743 (0.500) | -1.100* (0.660) | -0.266 (0.668) |
| $\beta_3 : 1\{R_i \geq R_d\} \times R_i \times D_{it,1}$ | | | 0.708** (0.286) | 0.860** (0.340) | 1.355*** (0.414) | 2.182*** (0.592) | 2.563*** (0.900) |
| N | 115416 | 30888 | 42672 | 36840 | 30888 | 24936 | 18600 |
| Households | | | 1778 | 1535 | 1287 | 1039 | 775 |

Notes: Estimates restricted to households re-enrolling within 6 months of their initial challenge. *** p<0.01, ** p<0.05,

* p<0.1.

Appendix H Event Study Estimates For All Households

This section presents the individual monthly point estimates plotted in Figure 1 and B.1.

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|-------------|----------------------|-----------------------|-------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M-119 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-118 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-117 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-116 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-115 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-114 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-113 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-112 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-111 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-110 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-109 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-108 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-107 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-106 | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-105 | 0 | 0 | 0 | 0 |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|----------------------|----------------------|-----------------------|----------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| | (.) | (.) | (.) | (.) |
| M-104 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| M-103 | 0 | 0 | 0 | 0 |
| | (.) | (.) | (.) | (.) |
| M-102 | -0.0966 (0.0782) | -0.114 (0.0780) | -0.0968 (0.117) | -0.172 (0.113) |
| M-101 | -0.0142 (0.0428) | -0.0322 (0.0426) | 0.0137 (0.0691) | -0.0842 (0.0619) |
| M-100 | -0.0395 (0.0315) | -0.0572 (0.0313) | -0.00537 (0.0443) | -0.126* (0.0581) |
| M-99 | -0.0178 (0.0261) | -0.0340 (0.0259) | 0.00173 (0.0339) | -0.0684 (0.0507) |
| M-98 | 0.00579 (0.0197) | -0.00746 (0.0194) | 0.0162 (0.0245) | -0.0190 (0.0375) |
| M-97 | -0.00313 (0.0196) | -0.0138 (0.0194) | -0.00935 (0.0279) | 0.00697 (0.0296) |
| M-96 | 0.0157 (0.0153) | 0.00671 (0.0149) | 0.00735 (0.0203) | 0.0305 (0.0252) |
| M-95 | 0.0112 (0.0140) | 0.00409 (0.0137) | 0.0139 (0.0179) | 0.0278 (0.0230) |
| M-94 | 0.0267* (0.0133) | 0.0213 (0.0130) | 0.0300 (0.0170) | 0.0479* (0.0219) |
| M-93 | 0.0238* (0.0117) | 0.0179 (0.0114) | 0.0229 (0.0155) | 0.0249 (0.0208) |
| M-92 | 0.0299** (0.0107) | 0.0242* (0.0104) | 0.0205 (0.0143) | 0.0372* (0.0187) |
| M-91 | 0.0201 (0.0112) | 0.0151 (0.0109) | 0.0224 (0.0134) | 0.00979 (0.0232) |
| M-90 | 0.0225* (0.0113) | 0.0182 (0.0110) | 0.0186 (0.0131) | 0.0201 (0.0231) |
| M-89 | 0.0176 (0.0108) | 0.0135 (0.0105) | 0.0132 (0.0129) | 0.0145 (0.0221) |
| M-88 | 0.0126 (0.0111) | 0.00866 (0.0108) | 0.0157 (0.0128) | -0.00574 (0.0237) |
| M-87 | 0.0222* (0.0222*) | 0.0178 (0.0178) | 0.0231 (0.0231) | 0.0135 (0.0135) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|------------------------|------------------------|-----------------------|----------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M-86 | (0.0103) | (0.0100) | (0.0124) | (0.0199) |
| | 0.0267** (0.00954) | 0.0219* (0.00925) | 0.0217 (0.0121) | 0.0253 (0.0181) |
| M-85 | 0.0287** (0.00890) | 0.0233** (0.00859) | 0.0259* (0.0112) | 0.0261 (0.0168) |
| M-84 | 0.0247** (0.00883) | 0.0189* (0.00853) | 0.0292** (0.0109) | 0.0223 (0.0171) |
| M-83 | 0.0253** (0.00882) | 0.0196* (0.00852) | 0.0273* (0.0110) | 0.0310 (0.0170) |
| M-82 | 0.0319*** (0.00858) | 0.0269** (0.00829) | 0.0313** (0.0110) | 0.0478** (0.0159) |
| M-81 | 0.0221* (0.00878) | 0.0174* (0.00852) | 0.0234* (0.0107) | 0.0357* (0.0163) |
| M-80 | 0.0273*** (0.00826) | 0.0226** (0.00800) | 0.0210* (0.0101) | 0.0371* (0.0159) |
| M-79 | 0.0233** (0.00835) | 0.0187* (0.00811) | 0.0243* (0.00974) | 0.0102 (0.0174) |
| M-78 | 0.0239** (0.00804) | 0.0186* (0.00780) | 0.0165 (0.00934) | 0.0238 (0.0162) |
| M-77 | 0.0210** (0.00783) | 0.0153* (0.00760) | 0.0102 (0.00938) | 0.0264 (0.0155) |
| M-76 | 0.0182* (0.00773) | 0.0120 (0.00750) | 0.0119 (0.00936) | 0.0162 (0.0153) |
| M-75 | 0.0228** (0.00777) | 0.0167* (0.00755) | 0.0119 (0.00944) | 0.0305* (0.0154) |
| M-74 | 0.0190* (0.00755) | 0.0130 (0.00732) | 0.0106 (0.00914) | 0.0211 (0.0150) |
| M-73 | 0.00612 (0.00811) | -0.000135 (0.00790) | 0.00459 (0.00991) | 0.0129 (0.0146) |
| M-72 | 0.0145 (0.00745) | 0.00798 (0.00722) | 0.0109 (0.00963) | 0.0231 (0.0136) |
| M-71 | 0.0184** (0.00713) | 0.0121 (0.00691) | 0.0154 (0.00917) | 0.0307* (0.0132) |
| M-70 | 0.0239*** (0.00689) | 0.0176** (0.00667) | 0.0220* (0.00887) | 0.0369** (0.0129) |
| M-69 | 0.0197** (0.0197*) | 0.0138* (0.0138*) | 0.0181* (0.0181*) | 0.0318* (0.0318*) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|------------------------|------------------------|------------------------|------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| | (0.00677) | (0.00655) | (0.00871) | (0.0125) |
| M-68 | 0.0250*** (0.00651) | 0.0197** (0.00631) | 0.0270*** (0.00792) | 0.0254 (0.0131) |
| M-67 | 0.0119 (0.00678) | 0.00662 (0.00660) | 0.0111 (0.00857) | 0.00537 (0.0130) |
| M-66 | 0.0161* (0.00649) | 0.0104 (0.00632) | 0.0136 (0.00810) | 0.0100 (0.0126) |
| M-65 | 0.0255*** (0.00630) | 0.0188** (0.00612) | 0.0238** (0.00772) | 0.0240 (0.0126) |
| M-64 | 0.0249*** (0.00599) | 0.0179** (0.00581) | 0.0239*** (0.00716) | 0.0204 (0.0123) |
| M-63 | 0.0256*** (0.00604) | 0.0188** (0.00586) | 0.0255*** (0.00726) | 0.0199 (0.0123) |
| M-62 | 0.0270*** (0.00583) | 0.0208*** (0.00566) | 0.0248*** (0.00707) | 0.0245* (0.0121) |
| M-61 | 0.0263*** (0.00571) | 0.0207*** (0.00554) | 0.0265*** (0.00684) | 0.0150 (0.0119) |
| M-60 | 0.0251*** (0.00581) | 0.0201*** (0.00565) | 0.0243*** (0.00714) | 0.0193 (0.0114) |
| M-59 | 0.0284*** (0.00553) | 0.0238*** (0.00538) | 0.0276*** (0.00666) | 0.0281* (0.0114) |
| M-58 | 0.0331*** (0.00545) | 0.0287*** (0.00529) | 0.0293*** (0.00681) | 0.0465*** (0.0105) |
| M-57 | 0.0257*** (0.00549) | 0.0210*** (0.00535) | 0.0267*** (0.00664) | 0.0369*** (0.0103) |
| M-56 | 0.0260*** (0.00521) | 0.0210*** (0.00507) | 0.0277*** (0.00642) | 0.0330*** (0.00999) |
| M-55 | 0.0175** (0.00546) | 0.0124* (0.00534) | 0.0176** (0.00676) | 0.0206 (0.0106) |
| M-54 | 0.0202*** (0.00532) | 0.0150** (0.00521) | 0.0183** (0.00651) | 0.0237* (0.0106) |
| M-53 | 0.0180*** (0.00535) | 0.0124* (0.00524) | 0.0178** (0.00642) | 0.0160 (0.0110) |
| M-52 | 0.0211*** (0.00512) | 0.0152** (0.00501) | 0.0202** (0.00623) | 0.0188 (0.0102) |
| M-51 | 0.0228*** (0.00512) | 0.0171*** (0.00501) | 0.0227*** (0.00623) | 0.0130 (0.0102) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|------------------------|------------------------|------------------------|------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| | (0.00496) | (0.00486) | (0.00609) | (0.0101) |
| M-50 | 0.0252*** (0.00485) | 0.0200*** (0.00476) | 0.0243*** (0.00590) | 0.0165 (0.00988) |
| M-49 | 0.0279*** (0.00480) | 0.0235*** (0.00471) | 0.0269*** (0.00589) | 0.0212* (0.00976) |
| M-48 | 0.0306*** (0.00480) | 0.0268*** (0.00472) | 0.0258*** (0.00611) | 0.0307** (0.00948) |
| M-47 | 0.0280*** (0.00469) | 0.0246*** (0.00461) | 0.0213*** (0.00589) | 0.0349*** (0.00944) |
| M-46 | 0.0277*** (0.00454) | 0.0242*** (0.00446) | 0.0217*** (0.00561) | 0.0374*** (0.00908) |
| M-45 | 0.0238*** (0.00450) | 0.0200*** (0.00442) | 0.0208*** (0.00542) | 0.0316*** (0.00922) |
| M-44 | 0.0213*** (0.00438) | 0.0175*** (0.00431) | 0.0204*** (0.00521) | 0.0254** (0.00905) |
| M-43 | 0.0135** (0.00448) | 0.00982* (0.00442) | 0.0149** (0.00519) | 0.0150 (0.00950) |
| M-42 | 0.0137** (0.00453) | 0.00995* (0.00448) | 0.0149** (0.00546) | 0.0126 (0.00927) |
| M-41 | 0.0142** (0.00446) | 0.0101* (0.00441) | 0.0150** (0.00535) | 0.00865 (0.00916) |
| M-40 | 0.0165*** (0.00433) | 0.0120** (0.00429) | 0.0143** (0.00516) | 0.0140 (0.00894) |
| M-39 | 0.0144*** (0.00433) | 0.00984* (0.00429) | 0.0121* (0.00530) | 0.00898 (0.00894) |
| M-38 | 0.0188*** (0.00415) | 0.0146*** (0.00411) | 0.0172*** (0.00492) | 0.0123 (0.00892) |
| M-37 | 0.0182*** (0.00413) | 0.0147*** (0.00409) | 0.0190*** (0.00473) | 0.00844 (0.00904) |
| M-36 | 0.0178*** (0.00412) | 0.0149*** (0.00409) | 0.0167*** (0.00498) | 0.0131 (0.00863) |
| M-35 | 0.0180*** (0.00408) | 0.0154*** (0.00405) | 0.0164*** (0.00498) | 0.0160 (0.00843) |
| M-34 | 0.0182*** (0.00396) | 0.0155*** (0.00393) | 0.0169*** (0.00485) | 0.0235** (0.00817) |
| M-33 | 0.00970* (0.00396) | 0.00654 (0.00393) | 0.0109* (0.00485) | 0.0169* (0.00817) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|------------------------|------------------------|-----------------------|----------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M-32 | (0.00390) 0.00584 | (0.00388) 0.00242 | (0.00486) 0.00793 | (0.00770) 0.00950 |
| M-31 | (0.00381) 0.00449 | (0.00378) 0.000985 | (0.00469) 0.00615 | (0.00762) 0.00449 |
| M-30 | (0.00394) 0.00678 | (0.00392) 0.00348 | (0.00450) 0.00660 | (0.00877) 0.00780 |
| M-29 | (0.00355) 0.00740* | (0.00353) 0.00444 | (0.00418) 0.00634 | (0.00741) 0.0108 |
| M-28 | (0.00345) 0.00932** | (0.00344) 0.00682* | (0.00418) 0.00533 | (0.00698) 0.0147* |
| M-27 | (0.00329) 0.00794* | (0.00329) 0.00606 | (0.00393) 0.00637 | (0.00686) 0.00641 |
| M-26 | (0.00319) 0.00963** | (0.00319) 0.00843** | (0.00380) 0.00697 | (0.00671) 0.00709 |
| M-25 | (0.00315) 0.00647* | (0.00315) 0.00594 | (0.00371) 0.00606 | (0.00672) 0.00181 |
| M-24 | (0.00300) 0.00726* | (0.00300) 0.00676* | (0.00360) 0.00610 | (0.00631) 0.00943 |
| M-23 | | | | |
| M-22 | | | | |
| M-21 | | | | |
| M-20 | | | | |
| M-19 | | | | |
| M-18 | | | | |
| M-17 | | | | |
| M-16 | | | | |
| M-15 | | | | |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|-------------------------|-------------------------|-------------------------|-------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M-14 | | | | |
| M-13 | | | | |
| M-12 | | | | |
| M-11 | 0.00167 (0.00285) | 0.00401 (0.00285) | 0.00321 (0.00335) | -0.000322 (0.00607) |
| M-10 | 0.00243 (0.00288) | 0.00416 (0.00287) | 0.00139 (0.00338) | 0.00869 (0.00606) |
| M-9 | 0.00102 (0.00296) | 0.00173 (0.00294) | -0.000283 (0.00352) | 0.0130* (0.00602) |
| M-8 | -0.00484 (0.00311) | -0.00520 (0.00309) | -0.00453 (0.00368) | 0.00196 (0.00653) |
| M-7 | -0.00341 (0.00317) | -0.00441 (0.00315) | -0.00319 (0.00368) | 0.00191 (0.00651) |
| M-6 | -0.00253 (0.00309) | -0.00350 (0.00307) | -0.00188 (0.00379) | -0.000811 (0.00623) |
| M-5 | -0.00364 (0.00313) | -0.00417 (0.00311) | -0.00372 (0.00382) | -0.00254 (0.00637) |
| M-4 | -0.00476 (0.00315) | -0.00454 (0.00313) | -0.00525 (0.00375) | -0.00701 (0.00659) |
| M-3 | -0.0106** (0.00322) | -0.00936** (0.00319) | -0.0125** (0.00394) | -0.0108 (0.00649) |
| M-2 | -0.00833** (0.00319) | -0.00612 (0.00317) | -0.0102** (0.00386) | -0.00604 (0.00652) |
| M-1 | -0.0173*** (0.00337) | -0.0143*** (0.00334) | -0.0174*** (0.00397) | -0.0220** (0.00721) |
| M0 | -0.0219*** (0.00328) | -0.0188*** (0.00325) | -0.0228*** (0.00396) | -0.0243*** (0.00693) |
| M1 | -0.0410*** (0.00352) | -0.0380*** (0.00348) | -0.0392*** (0.00421) | -0.0486*** (0.00742) |
| M2 | -0.0490*** (0.00359) | -0.0466*** (0.00355) | -0.0463*** (0.00431) | -0.0545*** (0.00738) |
| M3 | -0.0514*** (0.00359) | -0.0501*** (0.00355) | -0.0473*** (0.00431) | -0.0578*** (0.00738) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|-------------|----------------------|-----------------------|-------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M4 | (0.00357) | (0.00352) | (0.00433) | (0.00707) |
| | -0.0524*** | -0.0525*** | -0.0460*** | -0.0637*** |
| M5 | (0.00353) | (0.00347) | (0.00429) | (0.00709) |
| | -0.0508*** | -0.0515*** | -0.0445*** | -0.0631*** |
| M6 | (0.00366) | (0.00360) | (0.00437) | (0.00753) |
| | -0.0496*** | -0.0502*** | -0.0432*** | -0.0639*** |
| M7 | (0.00367) | (0.00360) | (0.00448) | (0.00756) |
| | -0.0487*** | -0.0485*** | -0.0438*** | -0.0616*** |
| M8 | (0.00360) | (0.00353) | (0.00433) | (0.00752) |
| | -0.0506*** | -0.0493*** | -0.0454*** | -0.0678*** |
| M9 | (0.00364) | (0.00357) | (0.00441) | (0.00756) |
| | -0.0539*** | -0.0516*** | -0.0486*** | -0.0704*** |
| M10 | (0.00377) | (0.00370) | (0.00451) | (0.00774) |
| | -0.0494*** | -0.0458*** | -0.0448*** | -0.0659*** |
| M11 | (0.00380) | (0.00373) | (0.00461) | (0.00803) |
| | -0.0503*** | -0.0457*** | -0.0477*** | -0.0635*** |
| M12 | (0.00371) | (0.00363) | (0.00456) | (0.00775) |
| | -0.0499*** | -0.0451*** | -0.0485*** | -0.0590*** |
| M13 | (0.00372) | (0.00363) | (0.00463) | (0.00769) |
| | -0.0533*** | -0.0488*** | -0.0490*** | -0.0636*** |
| M14 | (0.00381) | (0.00372) | (0.00472) | (0.00768) |
| | -0.0553*** | -0.0514*** | -0.0500*** | -0.0679*** |
| M15 | (0.00382) | (0.00372) | (0.00469) | (0.00772) |
| | -0.0567*** | -0.0537*** | -0.0511*** | -0.0697*** |
| M16 | (0.00387) | (0.00376) | (0.00467) | (0.00799) |
| | -0.0579*** | -0.0560*** | -0.0523*** | -0.0740*** |
| M17 | (0.00387) | (0.00376) | (0.00469) | (0.00805) |
| | -0.0590*** | -0.0581*** | -0.0546*** | -0.0742*** |
| M18 | (0.00391) | (0.00379) | (0.00474) | (0.00813) |
| | -0.0598*** | -0.0588*** | -0.0542*** | -0.0812*** |
| M19 | (0.00395) | (0.00382) | (0.00477) | (0.00829) |
| | -0.0609*** | -0.0591*** | -0.0537*** | -0.0805*** |
| M20 | (0.00394) | (0.00381) | (0.00474) | (0.00814) |
| | -0.0591*** | -0.0562*** | -0.0546*** | -0.0745*** |
| M21 | (0.00404) | (0.00391) | (0.00494) | (0.00825) |
| | -0.0610*** | -0.0568*** | -0.0535*** | -0.0826*** |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|--------------------------------------|--------------------------------------|--------------------------------------|--------------------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M22 | (0.00411) -0.0531*** (0.00408) | (0.00397) -0.0473*** (0.00395) | (0.00507) -0.0483*** (0.00504) | (0.00836) -0.0692*** (0.00838) |
| M23 | (0.00415) -0.0543*** (0.00415) | (0.00401) -0.0472*** (0.00401) | (0.00513) -0.0518*** (0.00513) | (0.00859) -0.0702*** (0.00859) |
| M24 | (0.00421) -0.0511*** (0.00421) | (0.00407) -0.0434*** (0.00407) | (0.00530) -0.0498*** (0.00530) | (0.00865) -0.0642*** (0.00865) |
| M25 | (0.00431) -0.0521*** (0.00431) | (0.00416) -0.0449*** (0.00416) | (0.00536) -0.0492*** (0.00536) | (0.00879) -0.0672*** (0.00879) |
| M26 | (0.00431) -0.0557*** (0.00431) | (0.00415) -0.0493*** (0.00415) | (0.00533) -0.0507*** (0.00533) | (0.00882) -0.0691*** (0.00882) |
| M27 | (0.00437) -0.0544*** (0.00437) | (0.00420) -0.0488*** (0.00420) | (0.00542) -0.0496*** (0.00542) | (0.00880) -0.0642*** (0.00880) |
| M28 | (0.00445) -0.0553*** (0.00445) | (0.00427) -0.0513*** (0.00427) | (0.00557) -0.0528*** (0.00557) | (0.00900) -0.0658*** (0.00900) |
| M29 | (0.00449) -0.0553*** (0.00449) | (0.00431) -0.0524*** (0.00431) | (0.00559) -0.0528*** (0.00559) | (0.00923) -0.0687*** (0.00923) |
| M30 | (0.00453) -0.0562*** (0.00453) | (0.00434) -0.0534*** (0.00434) | (0.00565) -0.0537*** (0.00565) | (0.00935) -0.0667*** (0.00935) |
| M31 | (0.00451) -0.0543*** (0.00451) | (0.00431) -0.0508*** (0.00431) | (0.00555) -0.0500*** (0.00555) | (0.00933) -0.0661*** (0.00933) |
| M32 | (0.00459) -0.0530*** (0.00459) | (0.00438) -0.0487*** (0.00438) | (0.00567) -0.0470*** (0.00567) | (0.00949) -0.0709*** (0.00949) |
| M33 | (0.00466) -0.0542*** (0.00466) | (0.00445) -0.0482*** (0.00445) | (0.00576) -0.0476*** (0.00576) | (0.00942) -0.0733*** (0.00942) |
| M34 | (0.00474) -0.0495*** (0.00474) | (0.00453) -0.0415*** (0.00453) | (0.00591) -0.0464*** (0.00591) | (0.00950) -0.0636*** (0.00950) |
| M35 | (0.00472) -0.0467*** (0.00472) | (0.00451) -0.0371*** (0.00451) | (0.00594) -0.0465*** (0.00594) | (0.00954) -0.0584*** (0.00954) |
| M36 | (0.00471) -0.0392*** (0.00471) | (0.00448) -0.0297*** (0.00448) | (0.00591) -0.0408*** (0.00591) | (0.00949) -0.0500*** (0.00949) |
| M37 | (0.00480) -0.0435*** (0.00480) | (0.00457) -0.0344*** (0.00457) | (0.00603) -0.0424*** (0.00603) | (0.00959) -0.0584*** (0.00959) |
| M38 | (0.00485) -0.0498*** (0.00485) | (0.00461) -0.0415*** (0.00461) | (0.00607) -0.0464*** (0.00607) | (0.00977) -0.0666*** (0.00977) |
| M39 | -0.0475*** (0.00485) | -0.0403*** (0.00485) | -0.0407*** (0.00485) | -0.0653*** (0.00485) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|-------------------------|-------------------------|-------------------------|------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| | (0.00487) | (0.00462) | (0.00600) | (0.0101) |
| M40 | -0.0471*** (0.00494) | -0.0417*** (0.00468) | -0.0418*** (0.00611) | -0.0590*** (0.0103) |
| M41 | -0.0481*** (0.00499) | -0.0440*** (0.00472) | -0.0410*** (0.00625) | -0.0649*** (0.0102) |
| M42 | -0.0515*** (0.00502) | -0.0473*** (0.00475) | -0.0469*** (0.00630) | -0.0655*** (0.0102) |
| M43 | -0.0503*** (0.00504) | -0.0452*** (0.00477) | -0.0473*** (0.00632) | -0.0639*** (0.0102) |
| M44 | -0.0500*** (0.00512) | -0.0436*** (0.00483) | -0.0493*** (0.00646) | -0.0592*** (0.0103) |
| M45 | -0.0495*** (0.00522) | -0.0418*** (0.00493) | -0.0462*** (0.00658) | -0.0648*** (0.0105) |
| M46 | -0.0449*** (0.00529) | -0.0355*** (0.00500) | -0.0428*** (0.00668) | -0.0590*** (0.0106) |
| M47 | -0.0426*** (0.00525) | -0.0315*** (0.00496) | -0.0443*** (0.00667) | -0.0557*** (0.0106) |
| M48 | -0.0392*** (0.00528) | -0.0273*** (0.00498) | -0.0385*** (0.00673) | -0.0540*** (0.0106) |
| M49 | -0.0407*** (0.00532) | -0.0296*** (0.00501) | -0.0395*** (0.00673) | -0.0558*** (0.0107) |
| M50 | -0.0447*** (0.00539) | -0.0346*** (0.00508) | -0.0397*** (0.00670) | -0.0632*** (0.0110) |
| M51 | -0.0479*** (0.00559) | -0.0396*** (0.00526) | -0.0370*** (0.00680) | -0.0711*** (0.0117) |
| M52 | -0.0484*** (0.00549) | -0.0418*** (0.00516) | -0.0371*** (0.00675) | -0.0729*** (0.0114) |
| M53 | -0.0444*** (0.00553) | -0.0392*** (0.00519) | -0.0386*** (0.00687) | -0.0606*** (0.0115) |
| M54 | -0.0480*** (0.00562) | -0.0426*** (0.00527) | -0.0418*** (0.00695) | -0.0583*** (0.0117) |
| M55 | -0.0475*** (0.00582) | -0.0402*** (0.00547) | -0.0451*** (0.00747) | -0.0553*** (0.0116) |
| M56 | -0.0451*** (0.00576) | -0.0358*** (0.00540) | -0.0390*** (0.00715) | -0.0610*** (0.0117) |
| M57 | -0.0541*** (0.00576) | -0.0432*** (0.00544) | -0.0489*** (0.00715) | -0.0722*** (0.0117) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|--------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M58 | (0.00590) -0.0467*** (0.00593) | (0.00555) -0.0339*** (0.00556) | (0.00736) -0.0452*** (0.00749) | (0.0120) -0.0622*** (0.0119) |
| M59 | (0.00593) -0.0424*** (0.00593) | (0.00556) -0.0280*** (0.00555) | (0.00749) -0.0427*** (0.00752) | (0.0119) -0.0516*** (0.0118) |
| M60 | (0.00597) -0.0388*** (0.00597) | (0.00558) -0.0255*** (0.00558) | (0.00752) -0.0377*** (0.00752) | (0.0120) -0.0498*** (0.0120) |
| M61 | (0.00612) -0.0410*** (0.00612) | (0.00573) -0.0290*** (0.00573) | (0.00760) -0.0385*** (0.00760) | (0.0124) -0.0506*** (0.0124) |
| M62 | (0.00617) -0.0416*** (0.00617) | (0.00578) -0.0308*** (0.00578) | (0.00773) -0.0366*** (0.00773) | (0.0122) -0.0568*** (0.0122) |
| M63 | (0.00625) -0.0450*** (0.00625) | (0.00585) -0.0357*** (0.00585) | (0.00781) -0.0368*** (0.00781) | (0.0122) -0.0639*** (0.0122) |
| M64 | (0.00629) -0.0505*** (0.00629) | (0.00587) -0.0431*** (0.00587) | (0.00794) -0.0439*** (0.00794) | (0.0124) -0.0677*** (0.0124) |
| M65 | (0.00633) -0.0472*** (0.00633) | (0.00591) -0.0410*** (0.00591) | (0.00808) -0.0449*** (0.00808) | (0.0124) -0.0580*** (0.0124) |
| M66 | (0.00637) -0.0468*** (0.00637) | (0.00594) -0.0400*** (0.00594) | (0.00811) -0.0440*** (0.00811) | (0.0125) -0.0603*** (0.0125) |
| M67 | (0.00649) -0.0521*** (0.00649) | (0.00605) -0.0432*** (0.00605) | (0.00815) -0.0460*** (0.00815) | (0.0130) -0.0732*** (0.0130) |
| M68 | (0.00655) -0.0525*** (0.00655) | (0.00611) -0.0411*** (0.00611) | (0.00824) -0.0455*** (0.00824) | (0.0129) -0.0759*** (0.0129) |
| M69 | (0.00668) -0.0548*** (0.00668) | (0.00623) -0.0408*** (0.00623) | (0.00824) -0.0471*** (0.00824) | (0.0135) -0.0745*** (0.0135) |
| M70 | (0.00669) -0.0527*** (0.00669) | (0.00625) -0.0367*** (0.00625) | (0.00820) -0.0425*** (0.00820) | (0.0136) -0.0759*** (0.0136) |
| M71 | (0.00677) -0.0455*** (0.00677) | (0.00633) -0.0285*** (0.00633) | (0.00843) -0.0403*** (0.00843) | (0.0136) -0.0616*** (0.0136) |
| M72 | (0.00687) -0.0439*** (0.00687) | (0.00642) -0.0271*** (0.00642) | (0.00840) -0.0395*** (0.00840) | (0.0142) -0.0565*** (0.0142) |
| M73 | (0.00695) -0.0432*** (0.00695) | (0.00649) -0.0279*** (0.00649) | (0.00857) -0.0366*** (0.00857) | (0.0141) -0.0638*** (0.0141) |
| M74 | (0.00703) -0.0482*** (0.00703) | (0.00656) -0.0344*** (0.00656) | (0.00878) -0.0407*** (0.00878) | (0.0139) -0.0644*** (0.0139) |
| M75 | -0.0458*** (0.00703) | -0.0347*** (0.00703) | -0.0395*** (0.00703) | -0.0617*** (0.00703) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|--------------------------------------|--------------------------------------|--------------------------------------|------------------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M76 | (0.00710) -0.0537*** (0.00728) | (0.00663) -0.0457*** (0.00681) | (0.00883) -0.0464*** (0.00898) | (0.0142) -0.0694*** (0.0149) |
| M77 | (0.00735) -0.0510*** (0.00735) | (0.00688) -0.0454*** (0.00688) | (0.00917) -0.0432*** (0.00917) | (0.0152) -0.0679*** (0.0152) |
| M78 | (0.00733) -0.0532*** (0.00733) | (0.00683) -0.0476*** (0.00683) | (0.00917) -0.0424*** (0.00917) | (0.0151) -0.0771*** (0.0151) |
| M79 | (0.00742) -0.0530*** (0.00742) | (0.00692) -0.0451*** (0.00692) | (0.00919) -0.0399*** (0.00919) | (0.0151) -0.0838*** (0.0151) |
| M80 | (0.00761) -0.0570*** (0.00761) | (0.00710) -0.0454*** (0.00710) | (0.00924) -0.0417*** (0.00924) | (0.0155) -0.0912*** (0.0155) |
| M81 | (0.00772) -0.0539*** (0.00772) | (0.00721) -0.0385*** (0.00721) | (0.00937) -0.0409*** (0.00937) | (0.0157) -0.0888*** (0.0157) |
| M82 | (0.00786) -0.0546*** (0.00786) | (0.00736) -0.0356*** (0.00736) | (0.00957) -0.0440*** (0.00957) | (0.0161) -0.0783*** (0.0161) |
| M83 | (0.00759) -0.0511*** (0.00759) | (0.00706) -0.0304*** (0.00706) | (0.00936) -0.0492*** (0.00936) | (0.0154) -0.0597*** (0.0154) |
| M84 | (0.00752) -0.0445*** (0.00752) | (0.00696) -0.0244*** (0.00696) | (0.00942) -0.0411*** (0.00942) | (0.0147) -0.0503*** (0.0147) |
| M85 | (0.00774) -0.0468*** (0.00774) | (0.00719) -0.0291*** (0.00719) | (0.00951) -0.0361*** (0.00951) | (0.0156) -0.0556*** (0.0156) |
| M86 | (0.00788) -0.0502*** (0.00788) | (0.00734) -0.0349*** (0.00734) | (0.00968) -0.0376*** (0.00968) | (0.0160) -0.0620*** (0.0160) |
| M87 | (0.00820) -0.0419*** (0.00820) | (0.00768) -0.0272*** (0.00768) | (0.0101) -0.0209* (0.0101) | (0.0167) -0.0721*** (0.0167) |
| M88 | (0.00847) -0.0448*** (0.00847) | (0.00795) -0.0326*** (0.00795) | (0.0102) -0.0314** (0.0102) | (0.0177) -0.0673*** (0.0177) |
| M89 | (0.00861) -0.0408*** (0.00861) | (0.00807) -0.0334*** (0.00807) | (0.0106) -0.0413*** (0.0106) | (0.0177) -0.0475** (0.0177) |
| M90 | (0.00875) -0.0499*** (0.00875) | (0.00820) -0.0443*** (0.00820) | (0.0109) -0.0438*** (0.0109) | (0.0177) -0.0714*** (0.0177) |
| M91 | (0.00922) -0.0641*** (0.00922) | (0.00866) -0.0570*** (0.00866) | (0.0110) -0.0477*** (0.0110) | (0.0191) -0.101*** (0.0191) |
| M92 | (0.00963) -0.0707*** (0.00963) | (0.00906) -0.0606*** (0.00906) | (0.0116) -0.0553*** (0.0116) | (0.0197) -0.105*** (0.0197) |
| M93 | -0.0597*** (0.00956) | -0.0452*** (0.00956) | -0.0391*** (0.00956) | -0.0956*** (0.00956) |

Table H.8: Event-Study Point Estimates

| | (1) Main | (2) All Non-Part. | (3) Non-Elec. Heat | (4) Elec. Heat |
|--|-------------------------|-------------------------|------------------------|------------------------|
| Dependent Variable: Ln monthly electricity use | | | | |
| M94 | (0.00963) -0.0584*** | (0.00905) -0.0402*** | (0.0117) -0.0498*** | (0.0193) -0.0706*** |
| M95 | (0.00963) -0.0600*** | (0.00905) -0.0383*** | (0.0118) -0.0545*** | (0.0194) -0.0621** |
| M96 | (0.00994) -0.0466*** | (0.00936) -0.0229* | (0.0125) -0.0400*** | (0.0195) -0.0552* |
| M97 | (0.0104) -0.0342** | (0.00987) -0.0114 | (0.0121) -0.0360** | (0.0223) -0.0207 |
| M98 | (0.0107) -0.0499*** | (0.0101) -0.0293** | (0.0129) -0.0458*** | (0.0218) -0.0416 |
| M99 | (0.0110) -0.0491*** | (0.0105) -0.0313** | (0.0134) -0.0490*** | (0.0229) -0.0513* |
| M100 | (0.0122) -0.0525*** | (0.0117) -0.0413*** | (0.0143) -0.0453** | (0.0268) -0.0753** |
| M101 | (0.0127) -0.0421*** | (0.0122) -0.0380** | (0.0152) -0.0512*** | (0.0257) -0.0271 |
| M102 | (0.0145) -0.0521*** | (0.0140) -0.0541*** | (0.0167) -0.0514** | (0.0320) -0.0807* |
| M103 | (0.0191) -0.0385* | (0.0187) -0.0409* | (0.0228) -0.0219 | (0.0398) -0.0832* |
| M104 | (0.0418) 0.0224 | (0.0418) 0.0284 | (0.0507) 0.0323 | (0.160) 0.0372 |
| M105 | (0.0430) 0.0422 | (0.0428) 0.0382 | (0.0459) 0.111* | (0.204) -0.114 |
| M106 | (0.0642) 0.0797 | (0.0641) 0.0740 | (0.0801) 0.174* | (0.231) -0.0752 |
| M107 | (0.00609) 0.464*** | (0.00483) 0.458*** | (0.00790) 0.512*** | (.) 0 |
| M108 | (.) 0 | (.) 0 | (.) 0 | (.) 0 |
| _cons | (0.00331) 6.775*** | (0.00250) 6.863*** | (0.00425) 6.678*** | (0.00667) 6.945*** |
| <hr/> | | | | |
| N | 2130468 | 3375167 | 1214158 | 626390 |

All specifications include individual and date fixed effects. Specification (1) estimated including both participant and non-participant households. (2) estimated for participant households only. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1 denote significance levels where 0 is defined as the second year pre-treatment and consists of months M-12 to M-23.

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|------------|------------|-------------|------------|---------------|--------------|--------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-119 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-118 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-117 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-116 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-115 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-114 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-113 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-112 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-111 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-110 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-109 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-108 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-107 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-106 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-105 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|----------------------|--------------------|-------------------|--------------------|--------------------|--------------------|--------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-104 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-103 | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M-102 | -0.0966 (0.0782) | -0.16 (0.17) | -0.074 (0.067) | -0.078 (0.067) | 0 (.) | 0 (.) | 0 (.) |
| M-101 | -0.0142 (0.0428) | -0.064 (0.077) | 0.0067 (0.047) | 0.0036 (0.048) | 0 (.) | 0 (.) | 0 (.) |
| M-100 | -0.0395 (0.0315) | -0.070 (0.056) | -0.037 (0.037) | -0.040 (0.037) | 0 (.) | 0 (.) | 0 (.) |
| M-99 | -0.0178 (0.0261) | -0.096* (0.044) | 0.012 (0.032) | 0.0096 (0.032) | 0 (.) | 0 (.) | 0 (.) |
| M-98 | 0.00579 (0.0197) | -0.062 (0.033) | 0.028 (0.024) | 0.026 (0.024) | 0 (.) | 0 (.) | 0 (.) |
| M-97 | -0.00313 (0.0196) | -0.068* (0.031) | 0.018 (0.025) | 0.015 (0.025) | 0 (.) | 0 (.) | 0 (.) |
| M-96 | 0.0157 (0.0153) | -0.028 (0.024) | 0.026 (0.019) | 0.024 (0.020) | 0 (.) | 0 (.) | 0 (.) |
| M-95 | 0.0112 (0.0140) | -0.026 (0.022) | 0.017 (0.018) | 0.015 (0.018) | 0 (.) | 0 (.) | 0 (.) |
| M-94 | 0.0267* (0.0133) | -0.0019 (0.021) | 0.028 (0.016) | 0.024 (0.017) | 0.081 (0.10) | 0.075 (0.10) | 0 (.) |
| M-93 | 0.0238* (0.0117) | 0.021 (0.017) | 0.0099 (0.015) | 0.0040 (0.017) | 0.042 (0.045) | 0.036 (0.045) | 0 (.) |
| M-92 | 0.0299** (0.0107) | 0.024 (0.016) | 0.018 (0.014) | 0.0043 (0.015) | 0.085** (0.032) | 0.079* (0.032) | 0 (.) |
| M-91 | 0.0201 (0.0112) | 0.016 (0.015) | 0.0069 (0.015) | -0.0063 (0.017) | 0.061* (0.029) | 0.056 (0.030) | 0 (.) |
| M-90 | 0.0225* (0.0113) | 0.019 (0.017) | 0.0089 (0.014) | -0.0045 (0.017) | 0.058* (0.027) | 0.052 (0.027) | 0 (.) |
| M-89 | 0.0176 (0.0108) | 0.012 (0.017) | 0.0062 (0.014) | 0.0064 (0.016) | -0.0041 (0.030) | -0.010 (0.030) | 0 (.) |
| M-88 | 0.0126 (0.0111) | -0.0091 (0.018) | 0.011 (0.013) | 0.012 (0.016) | 0.00067 (0.024) | -0.0052 (0.025) | 0 (.) |
| M-87 | 0.0222* (0.0103) | -0.012 (0.017) | 0.030* (0.012) | 0.037* (0.014) | 0.0037 (0.023) | -0.0019 (0.023) | 0 (.) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|------------------------|--------------------|----------------------|--------------------|---------------------|--------------------|--------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-86 | 0.0267** (0.00954) | 0.0023 (0.015) | 0.028* (0.012) | 0.036** (0.014) | 0.00027 (0.022) | -0.0055 (0.022) | 0 (.) |
| M-85 | 0.0287** (0.00890) | 0.0084 (0.014) | 0.027* (0.011) | 0.036** (0.014) | -0.00024 (0.020) | -0.0062 (0.020) | 0 (.) |
| M-84 | 0.0247** (0.00883) | 0.014 (0.013) | 0.017 (0.011) | 0.021 (0.014) | 0.0043 (0.021) | -0.0015 (0.021) | 0 (.) |
| M-83 | 0.0253** (0.00882) | 0.0085 (0.014) | 0.022* (0.011) | 0.017 (0.014) | 0.028 (0.018) | 0.023 (0.018) | 0 (.) |
| M-82 | 0.0319*** (0.00858) | 0.015 (0.014) | 0.029** (0.011) | 0.020 (0.013) | 0.045** (0.017) | 0.039* (0.017) | 0 (.) |
| M-81 | 0.0221* (0.00878) | 0.017 (0.014) | 0.012 (0.011) | 0.0032 (0.013) | 0.026 (0.020) | 0.022 (0.021) | -0.14** (0.048) |
| M-80 | 0.0273*** (0.00826) | 0.027* (0.013) | 0.015 (0.010) | 0.0046 (0.013) | 0.033* (0.017) | 0.029 (0.017) | 0.0029 (0.062) |
| M-79 | 0.0233** (0.00835) | 0.025 (0.013) | 0.0097 (0.010) | 0.0080 (0.013) | 0.0094 (0.018) | 0.0058 (0.019) | -0.022 (0.034) |
| M-78 | 0.0239** (0.00804) | 0.020 (0.013) | 0.013 (0.010) | 0.012 (0.013) | 0.012 (0.016) | 0.0054 (0.018) | 0.031 (0.037) |
| M-77 | 0.0210** (0.00783) | 0.024* (0.012) | 0.0062 (0.0100) | 0.0069 (0.013) | 0.0019 (0.016) | 0.0016 (0.017) | -0.043 (0.050) |
| M-76 | 0.0182* (0.00773) | 0.014 (0.012) | 0.0093 (0.0099) | 0.0096 (0.012) | 0.0062 (0.016) | 0.0050 (0.017) | -0.018 (0.042) |
| M-75 | 0.0228** (0.00777) | 0.020 (0.012) | 0.013 (0.010) | 0.019 (0.013) | 0.0010 (0.016) | -0.0028 (0.018) | -0.0017 (0.039) |
| M-74 | 0.0190* (0.00755) | 0.016 (0.012) | 0.0078 (0.0098) | 0.0089 (0.013) | 0.0042 (0.014) | -0.0074 (0.015) | 0.041 (0.032) |
| M-73 | 0.00612 (0.00811) | -0.0051 (0.013) | 0.00087 (0.010) | 0.0034 (0.015) | -0.0049 (0.014) | -0.012 (0.016) | 0.0065 (0.034) |
| M-72 | 0.0145 (0.00745) | 0.015 (0.012) | -0.00020 (0.0096) | 0.0012 (0.013) | -0.0042 (0.014) | -0.0022 (0.016) | -0.024 (0.026) |
| M-71 | 0.0184** (0.00713) | 0.017 (0.011) | 0.0054 (0.0091) | 0.0060 (0.012) | 0.0026 (0.014) | 0.00093 (0.016) | -0.0046 (0.024) |
| M-70 | 0.0239*** (0.00689) | 0.018 (0.011) | 0.012 (0.0088) | 0.010 (0.012) | 0.011 (0.013) | 0.016 (0.015) | -0.013 (0.025) |
| M-69 | 0.0197** (0.00677) | 0.017 (0.011) | 0.0070 (0.0086) | 0.0030 (0.012) | 0.0094 (0.012) | 0.015 (0.014) | -0.012 (0.023) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|------------------------|----------------------|---------------------|---------------------|--------------------|--------------------|--------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-68 | 0.0250*** (0.00651) | 0.030** (0.010) | 0.0080 (0.0084) | 0.0060 (0.012) | 0.0076 (0.012) | 0.015 (0.015) | -0.017 (0.021) |
| M-67 | 0.0119 (0.00678) | 0.020 (0.010) | -0.0049 (0.0089) | -0.016 (0.012) | 0.0054 (0.013) | 0.0042 (0.016) | 0.00020 (0.022) |
| M-66 | 0.0161* (0.00649) | 0.018 (0.010) | 0.0039 (0.0084) | -0.014 (0.012) | 0.021 (0.011) | 0.021 (0.014) | 0.013 (0.019) |
| M-65 | 0.0255*** (0.00630) | 0.028** (0.0099) | 0.014 (0.0081) | 0.0074 (0.011) | 0.017 (0.011) | 0.012 (0.015) | 0.018 (0.017) |
| M-64 | 0.0249*** (0.00599) | 0.025** (0.0096) | 0.012 (0.0077) | 0.0057 (0.011) | 0.016 (0.011) | 0.0049 (0.014) | 0.025 (0.016) |
| M-63 | 0.0256*** (0.00604) | 0.023* (0.010) | 0.017* (0.0074) | 0.014 (0.010) | 0.017 (0.010) | 0.0031 (0.014) | 0.030* (0.015) |
| M-62 | 0.0270*** (0.00583) | 0.026** (0.0092) | 0.015* (0.0076) | 0.012 (0.011) | 0.015 (0.010) | -0.0028 (0.015) | 0.032* (0.014) |
| M-61 | 0.0263*** (0.00571) | 0.031*** (0.0091) | 0.011 (0.0074) | 0.011 (0.011) | 0.0079 (0.0099) | -0.013 (0.014) | 0.026 (0.014) |
| M-60 | 0.0251*** (0.00581) | 0.031*** (0.0089) | 0.011 (0.0075) | 0.0092 (0.011) | 0.010 (0.010) | -0.0033 (0.013) | 0.021 (0.015) |
| M-59 | 0.0284*** (0.00553) | 0.032*** (0.0089) | 0.015* (0.0072) | 0.012 (0.011) | 0.015 (0.0094) | 0.0077 (0.012) | 0.018 (0.014) |
| M-58 | 0.0331*** (0.00545) | 0.041*** (0.0085) | 0.016* (0.0072) | 0.013 (0.011) | 0.016 (0.0094) | 0.015 (0.012) | 0.014 (0.014) |
| M-57 | 0.0257*** (0.00549) | 0.032*** (0.0085) | 0.0086 (0.0073) | 0.0049 (0.011) | 0.0091 (0.0097) | 0.016 (0.012) | -0.0015 (0.015) |
| M-56 | 0.0260*** (0.00521) | 0.031*** (0.0084) | 0.012 (0.0067) | 0.0042 (0.010) | 0.016 (0.0087) | 0.021 (0.011) | 0.0072 (0.013) |
| M-55 | 0.0175** (0.00546) | 0.020* (0.0088) | 0.0061 (0.0071) | -0.00100 (0.011) | 0.0097 (0.0093) | 0.0098 (0.012) | 0.0063 (0.014) |
| M-54 | 0.0202*** (0.00532) | 0.022** (0.0083) | 0.0076 (0.0071) | 0.0058 (0.011) | 0.0070 (0.0093) | 0.0014 (0.012) | 0.0089 (0.014) |
| M-53 | 0.0180*** (0.00535) | 0.021* (0.0085) | 0.0070 (0.0071) | 0.0044 (0.011) | 0.0071 (0.0093) | 0.00043 (0.013) | 0.0099 (0.013) |
| M-52 | 0.0211*** (0.00512) | 0.028*** (0.0081) | 0.0090 (0.0068) | 0.0094 (0.010) | 0.0068 (0.0087) | 0.0049 (0.012) | 0.0056 (0.012) |
| M-51 | 0.0228*** (0.00496) | 0.030*** (0.0080) | 0.013* (0.0064) | 0.019* (0.0093) | 0.0072 (0.0085) | 0.0051 (0.012) | 0.0061 (0.012) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|------------------------|----------------------|----------------------|---------------------|---------------------|---------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-50 | 0.0252*** (0.00485) | 0.036*** (0.0078) | 0.014* (0.0063) | 0.021* (0.0093) | 0.0063 (0.0084) | 0.00029 (0.013) | 0.0087 (0.011) |
| M-49 | 0.0279*** (0.00480) | 0.035*** (0.0078) | 0.016** (0.0063) | 0.024* (0.0096) | 0.0089 (0.0082) | 0.0037 (0.012) | 0.011 (0.011) |
| M-48 | 0.0306*** (0.00480) | 0.032*** (0.0080) | 0.022*** (0.0063) | 0.028** (0.0096) | 0.016* (0.0081) | 0.018 (0.011) | 0.012 (0.011) |
| M-47 | 0.0280*** (0.00469) | 0.024** (0.0078) | 0.020** (0.0061) | 0.023* (0.0095) | 0.016 (0.0079) | 0.019 (0.012) | 0.010 (0.010) |
| M-46 | 0.0277*** (0.00454) | 0.026*** (0.0072) | 0.019** (0.0061) | 0.024** (0.0092) | 0.014 (0.0080) | 0.015 (0.012) | 0.0093 (0.010) |
| M-45 | 0.0238*** (0.00450) | 0.026*** (0.0072) | 0.012* (0.0061) | 0.015 (0.0093) | 0.0088 (0.0080) | 0.016 (0.012) | 0.00070 (0.011) |
| M-44 | 0.0213*** (0.00438) | 0.027*** (0.0069) | 0.0087 (0.0060) | 0.0083 (0.0093) | 0.0075 (0.0077) | 0.023* (0.011) | -0.0070 (0.010) |
| M-43 | 0.0135** (0.00448) | 0.014* (0.0071) | 0.0035 (0.0061) | 0.0014 (0.0096) | 0.0039 (0.0079) | 0.0095 (0.012) | -0.0027 (0.010) |
| M-42 | 0.0137** (0.00453) | 0.011 (0.0075) | 0.0088 (0.0060) | 0.0051 (0.0093) | 0.010 (0.0078) | 0.023* (0.011) | -0.0012 (0.011) |
| M-41 | 0.0142** (0.00446) | 0.017* (0.0073) | 0.0084 (0.0060) | 0.011 (0.0096) | 0.0056 (0.0076) | 0.022* (0.011) | -0.0086 (0.010) |
| M-40 | 0.0165*** (0.00433) | 0.024*** (0.0068) | 0.0092 (0.0057) | 0.015 (0.0092) | 0.0037 (0.0071) | 0.012 (0.010) | -0.0047 (0.0097) |
| M-39 | 0.0144*** (0.00433) | 0.023*** (0.0069) | 0.0039 (0.0059) | 0.0094 (0.0097) | -0.0010 (0.0073) | 0.0072 (0.010) | -0.0090 (0.010) |
| M-38 | 0.0188*** (0.00415) | 0.024*** (0.0067) | 0.0076 (0.0057) | 0.0098 (0.0095) | 0.0051 (0.0069) | 0.0058 (0.010) | 0.0029 (0.0092) |
| M-37 | 0.0182*** (0.00413) | 0.023*** (0.0065) | 0.0091 (0.0058) | 0.014 (0.0092) | 0.0051 (0.0074) | -0.00095 (0.011) | 0.0080 (0.0097) |
| M-36 | 0.0178*** (0.00412) | 0.015* (0.0068) | 0.012* (0.0056) | 0.019* (0.0086) | 0.0065 (0.0073) | 0.0050 (0.011) | 0.0059 (0.010) |
| M-35 | 0.0180*** (0.00408) | 0.016* (0.0065) | 0.011 (0.0056) | 0.016 (0.0086) | 0.0065 (0.0074) | 0.0071 (0.011) | 0.0046 (0.0097) |
| M-34 | 0.0182*** (0.00396) | 0.015* (0.0066) | 0.012* (0.0054) | 0.015 (0.0085) | 0.0087 (0.0070) | 0.016 (0.0098) | 0.0017 (0.0097) |
| M-33 | 0.00970* (0.00390) | 0.013* (0.0064) | -0.00031 (0.0054) | 0.00083 (0.0086) | -0.0014 (0.0069) | 0.010 (0.0099) | -0.011 (0.0094) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|------------------------|---------------------|-----------------------|---------------------|----------------------|---------------------|----------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-32 | 0.00584 (0.00381) | 0.013* (0.0060) | -0.0075 (0.0055) | -0.013 (0.0092) | -0.0038 (0.0068) | 0.013 (0.010) | -0.016 (0.0092) |
| M-31 | 0.00449 (0.00394) | 0.0021 (0.0063) | -0.0051 (0.0058) | -0.0059 (0.0086) | -0.0046 (0.0078) | 0.0062 (0.011) | -0.013 (0.011) |
| M-30 | 0.00678 (0.00369) | 0.0041 (0.0061) | -0.000090 (0.0053) | -0.0017 (0.0085) | 0.00090 (0.0067) | 0.0071 (0.011) | -0.0041 (0.0085) |
| M-29 | 0.00740* (0.00355) | 0.012* (0.0056) | -0.0021 (0.0052) | -0.0053 (0.0087) | 0.000043 (0.0064) | 0.0097 (0.0098) | -0.0072 (0.0084) |
| M-28 | 0.00932** (0.00345) | 0.015** (0.0056) | -0.00015 (0.0050) | 0.00070 (0.0085) | -0.00087 (0.0060) | 0.0065 (0.0088) | -0.0064 (0.0082) |
| M-27 | 0.00794* (0.00329) | 0.0098 (0.0054) | 0.0050 (0.0046) | 0.012 (0.0073) | -0.00024 (0.0059) | 0.0063 (0.0085) | -0.0050 (0.0079) |
| M-26 | 0.00963** (0.00319) | 0.014** (0.0054) | 0.0046 (0.0044) | 0.012 (0.0070) | -0.00080 (0.0056) | -0.0025 (0.0085) | -0.00012 (0.0075) |
| M-25 | 0.00647* (0.00315) | 0.012* (0.0051) | 0.00036 (0.0045) | 0.0097 (0.0071) | -0.0062 (0.0059) | -0.012 (0.0087) | -0.0029 (0.0079) |
| M-24 | 0.00726* (0.00300) | 0.0081 (0.0048) | 0.0049 (0.0044) | 0.012 (0.0069) | 0.00030 (0.0057) | -0.0018 (0.0082) | 0.0015 (0.0078) |
| M-23 | | | | | | | |
| M-22 | | | | | | | |
| M-21 | | | | | | | |
| M-20 | | | | | | | |
| M-19 | | | | | | | |
| M-18 | | | | | | | |
| M-17 | | | | | | | |
| M-16 | | | | | | | |
| M-15 | | | | | | | |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M-14 | | | | | | | |
| M-13 | | | | | | | |
| M-12 | | | | | | | |
| M-11 | 0.00167 (0.00285) | 0.0029 (0.0044) | 0.0046 (0.0041) | 0.0072 (0.0065) | 0.0025 (0.0052) | -0.0039 (0.0084) | 0.0068 (0.0067) |
| M-10 | 0.00243 (0.00288) | 0.0013 (0.0045) | 0.0048 (0.0043) | 0.0064 (0.0065) | 0.0033 (0.0057) | 0.0020 (0.0082) | 0.0044 (0.0076) |
| M-9 | 0.00102 (0.00296) | 0.000042 (0.0047) | -0.00041 (0.0045) | -0.0011 (0.0073) | -0.00020 (0.0058) | 0.0012 (0.0091) | -0.00079 (0.0074) |
| M-8 | -0.00484 (0.00311) | -0.0066 (0.0051) | -0.0052 (0.0047) | -0.0099 (0.0075) | -0.0023 (0.0060) | 0.0020 (0.0093) | -0.0045 (0.0077) |
| M-7 | -0.00341 (0.00317) | -0.00025 (0.0049) | -0.0075 (0.0049) | -0.017* (0.0080) | -0.0013 (0.0062) | 0.00022 (0.0095) | -0.0017 (0.0080) |
| M-6 | -0.00253 (0.00309) | 0.0014 (0.0048) | -0.0065 (0.0049) | -0.018* (0.0081) | 0.00090 (0.0062) | -0.0022 (0.0095) | 0.0032 (0.0081) |
| M-5 | -0.00364 (0.00313) | 0.0018 (0.0048) | -0.0065 (0.0050) | -0.013 (0.0079) | -0.0022 (0.0064) | -0.0054 (0.0098) | 0.00014 (0.0084) |
| M-4 | -0.00476 (0.00315) | -0.000012 (0.0050) | -0.0074 (0.0049) | -0.0047 (0.0079) | -0.0099 (0.0061) | -0.024* (0.0098) | -0.00093 (0.0077) |
| M-3 | -0.0106** (0.00322) | -0.0038 (0.0052) | -0.012* (0.0049) | -0.0012 (0.0080) | -0.021*** (0.0062) | -0.039*** (0.010) | -0.0090 (0.0077) |
| M-2 | -0.00833** (0.00319) | 0.00046 (0.0050) | -0.012* (0.0049) | -0.010 (0.0084) | -0.014* (0.0060) | -0.032** (0.0097) | -0.0033 (0.0076) |
| M-1 | -0.0173*** (0.00337) | -0.0027 (0.0053) | -0.027*** (0.0053) | -0.032*** (0.0085) | -0.025*** (0.0066) | -0.049*** (0.010) | -0.0090 (0.0088) |
| M0 | -0.0219*** (0.00328) | -0.00036 (0.0051) | -0.040*** (0.0051) | -0.044*** (0.0084) | -0.037*** (0.0062) | -0.061*** (0.0097) | -0.022** (0.0080) |
| M1 | -0.0410*** (0.00352) | -0.013* (0.0056) | -0.068*** (0.0053) | -0.077*** (0.0089) | -0.062*** (0.0064) | -0.093*** (0.011) | -0.043*** (0.0080) |
| M2 | -0.0490*** (0.00359) | -0.017** (0.0055) | -0.077*** (0.0055) | -0.089*** (0.0094) | -0.069*** (0.0065) | -0.096*** (0.011) | -0.053*** (0.0082) |
| M3 | -0.0514*** (0.00357) | -0.018*** (0.0055) | -0.084*** (0.0055) | -0.096*** (0.0091) | -0.076*** (0.0068) | -0.097*** (0.011) | -0.063*** (0.0085) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M4 | -0.0524*** (0.00353) | -0.016** (0.0055) | -0.088*** (0.0053) | -0.099*** (0.0088) | -0.082*** (0.0066) | -0.096*** (0.011) | -0.073*** (0.0083) |
| M5 | -0.0508*** (0.00366) | -0.013* (0.0056) | -0.087*** (0.0056) | -0.097*** (0.0092) | -0.080*** (0.0070) | -0.099*** (0.011) | -0.068*** (0.0088) |
| M6 | -0.0496*** (0.00367) | -0.014* (0.0055) | -0.082*** (0.0058) | -0.098*** (0.0096) | -0.072*** (0.0071) | -0.098*** (0.012) | -0.056*** (0.0085) |
| M7 | -0.0487*** (0.00360) | -0.0094 (0.0056) | -0.081*** (0.0054) | -0.091*** (0.0087) | -0.074*** (0.0068) | -0.095*** (0.011) | -0.061*** (0.0086) |
| M8 | -0.0506*** (0.00364) | -0.0092 (0.0057) | -0.087*** (0.0054) | -0.096*** (0.0091) | -0.082*** (0.0066) | -0.099*** (0.011) | -0.070*** (0.0084) |
| M9 | -0.0539*** (0.00377) | -0.014* (0.0060) | -0.092*** (0.0056) | -0.094*** (0.0094) | -0.091*** (0.0068) | -0.10*** (0.011) | -0.083*** (0.0085) |
| M10 | -0.0494*** (0.00380) | -0.0081 (0.0059) | -0.088*** (0.0058) | -0.090*** (0.0096) | -0.087*** (0.0070) | -0.10*** (0.011) | -0.077*** (0.0091) |
| M11 | -0.0503*** (0.00371) | -0.0064 (0.0057) | -0.091*** (0.0056) | -0.093*** (0.0092) | -0.090*** (0.0070) | -0.11*** (0.011) | -0.077*** (0.0089) |
| M12 | -0.0499*** (0.00372) | -0.0027 (0.0056) | -0.092*** (0.0057) | -0.084*** (0.0093) | -0.098*** (0.0072) | -0.12*** (0.012) | -0.083*** (0.0087) |
| Gap 1 | 0 (.) | -0.085*** (0.0056) | -0.079*** (0.0092) | -0.088*** (0.0069) | -0.091*** (0.011) | -0.086*** (0.0087) | |
| M13 | -0.0533*** (0.00381) | -0.0084 (0.0058) | -0.11*** (0.0057) | -0.094*** (0.0090) | -0.11*** (0.0072) | -0.13*** (0.012) | -0.11*** (0.0090) |
| M14 | -0.0553*** (0.00382) | -0.015* (0.0060) | -0.11*** (0.0059) | -0.097*** (0.0096) | -0.12*** (0.0074) | -0.13*** (0.012) | -0.11*** (0.0094) |
| M15 | -0.0567*** (0.00387) | -0.011 (0.0059) | -0.11*** (0.0060) | -0.090*** (0.0096) | -0.12*** (0.0076) | -0.13*** (0.012) | -0.12*** (0.0095) |
| M16 | -0.0579*** (0.00387) | -0.0081 (0.0059) | -0.11*** (0.0060) | -0.091*** (0.0096) | -0.12*** (0.0076) | -0.13*** (0.013) | -0.11*** (0.0094) |
| M17 | -0.0590*** (0.00391) | -0.0099 (0.0060) | -0.10*** (0.0061) | -0.090*** (0.010) | -0.11*** (0.0073) | -0.13*** (0.012) | -0.10*** (0.0092) |
| M18 | -0.0598*** (0.00395) | -0.014* (0.0060) | -0.10*** (0.0062) | -0.094*** (0.010) | -0.11*** (0.0075) | -0.13*** (0.012) | -0.10*** (0.0095) |
| M19 | -0.0609*** (0.00394) | -0.015* (0.0060) | -0.11*** (0.0062) | -0.095*** (0.010) | -0.11*** (0.0077) | -0.13*** (0.012) | -0.10*** (0.0099) |
| M20 | -0.0591*** (0.00404) | -0.015* (0.0062) | -0.11*** (0.0062) | -0.092*** (0.010) | -0.12*** (0.0075) | -0.14*** (0.012) | -0.11*** (0.0096) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|---------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M21 | -0.0610*** (0.00411) | -0.014* (0.0061) | -0.11*** (0.0064) | -0.092*** (0.011) | -0.12*** (0.0075) | -0.13*** (0.012) | -0.11*** (0.0098) |
| M22 | -0.0531*** (0.00408) | -0.0024 (0.0060) | -0.099*** (0.0065) | -0.077*** (0.012) | -0.11*** (0.0075) | -0.12*** (0.012) | -0.11*** (0.0096) |
| M23 | -0.0543*** (0.00415) | -0.0050 (0.0061) | -0.099*** (0.0064) | -0.064*** (0.011) | -0.12*** (0.0078) | -0.13*** (0.012) | -0.11*** (0.0100) |
| M24 | -0.0511*** (0.00421) | -0.0031 (0.0063) | -0.097*** (0.0065) | -0.049*** (0.011) | -0.12*** (0.0079) | -0.13*** (0.013) | -0.11*** (0.0099) |
| Gap 2 | | 0 (.) | -0.098*** (0.0085) | 0 (.) | -0.11*** (0.0089) | -0.100*** (0.016) | -0.11*** (0.011) |
| M25 | -0.0521*** (0.00431) | -0.0054 (0.0064) | -0.10*** (0.0067) | -0.053*** (0.011) | -0.12*** (0.0079) | -0.12*** (0.012) | -0.13*** (0.010) |
| M26 | -0.0557*** (0.00431) | -0.010 (0.0064) | -0.10*** (0.0068) | -0.049*** (0.012) | -0.13*** (0.0081) | -0.13*** (0.013) | -0.13*** (0.010) |
| M27 | -0.0544*** (0.00437) | -0.0073 (0.0066) | -0.096*** (0.0069) | -0.039*** (0.012) | -0.12*** (0.0082) | -0.11*** (0.013) | -0.13*** (0.010) |
| M28 | -0.0553*** (0.00445) | -0.0054 (0.0065) | -0.096*** (0.0070) | -0.037** (0.012) | -0.12*** (0.0082) | -0.11*** (0.014) | -0.13*** (0.010) |
| M29 | -0.0553*** (0.00449) | -0.0046 (0.0067) | -0.093*** (0.0071) | -0.041** (0.013) | -0.12*** (0.0082) | -0.097*** (0.014) | -0.13*** (0.010) |
| M30 | -0.0562*** (0.00453) | -0.011 (0.0070) | -0.092*** (0.0072) | -0.046*** (0.013) | -0.11*** (0.0083) | -0.095*** (0.014) | -0.12*** (0.010) |
| M31 | -0.0543*** (0.00451) | -0.0093 (0.0069) | -0.096*** (0.0076) | -0.041** (0.013) | -0.12*** (0.0090) | -0.093*** (0.015) | -0.13*** (0.011) |
| M32 | -0.0530*** (0.00459) | -0.0038 (0.0069) | -0.094*** (0.0075) | -0.049*** (0.013) | -0.11*** (0.0089) | -0.089*** (0.016) | -0.12*** (0.010) |
| M33 | -0.0542*** (0.00466) | -0.0028 (0.0072) | -0.096*** (0.0075) | -0.056*** (0.013) | -0.11*** (0.0089) | -0.074*** (0.016) | -0.13*** (0.011) |
| M34 | -0.0495*** (0.00474) | 0.0021 (0.0070) | -0.093*** (0.0076) | -0.047*** (0.014) | -0.11*** (0.0089) | -0.058*** (0.016) | -0.13*** (0.011) |
| M35 | -0.0467*** (0.00472) | 0.0050 (0.0070) | -0.094*** (0.0077) | -0.037** (0.014) | -0.12*** (0.0090) | -0.065*** (0.016) | -0.14*** (0.011) |
| M36 | -0.0392*** (0.00471) | 0.014 (0.0070) | -0.092*** (0.0078) | -0.028* (0.013) | -0.12*** (0.0093) | -0.065*** (0.017) | -0.14*** (0.011) |
| Gap 3 | | 0 (.) | -0.089*** (0.011) | 0 (.) | -0.100*** (0.011) | 0 (.) | -0.10*** (0.012) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|--------------------|-----------------------|---------------------|----------------------|----------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M37 | -0.0435*** (0.00480) | 0.0047 (0.0072) | -0.092*** (0.0080) | -0.028* (0.013) | -0.12*** (0.0095) | -0.051** (0.016) | -0.14*** (0.011) |
| M38 | -0.0498*** (0.00485) | 0.0012 (0.0072) | -0.097*** (0.0083) | -0.021 (0.014) | -0.13*** (0.0099) | -0.060*** (0.017) | -0.15*** (0.012) |
| M39 | -0.0475*** (0.00487) | 0.0046 (0.0072) | -0.098*** (0.0082) | -0.027 (0.014) | -0.13*** (0.0096) | -0.062*** (0.016) | -0.15*** (0.012) |
| M40 | -0.0471*** (0.00494) | 0.0036 (0.0072) | -0.092*** (0.0083) | -0.025 (0.014) | -0.12*** (0.0099) | -0.067*** (0.017) | -0.14*** (0.012) |
| M41 | -0.0481*** (0.00499) | 0.0063 (0.0073) | -0.093*** (0.0085) | -0.038* (0.015) | -0.12*** (0.0099) | -0.066*** (0.017) | -0.13*** (0.012) |
| M42 | -0.0515*** (0.00502) | 0.0021 (0.0074) | -0.090*** (0.0085) | -0.036* (0.014) | -0.11*** (0.010) | -0.056** (0.019) | -0.13*** (0.012) |
| M43 | -0.0503*** (0.00504) | 0.0014 (0.0074) | -0.086*** (0.0085) | -0.033* (0.014) | -0.11*** (0.010) | -0.054** (0.019) | -0.13*** (0.012) |
| M44 | -0.0500*** (0.00512) | 0.0051 (0.0075) | -0.088*** (0.0087) | -0.040** (0.015) | -0.11*** (0.010) | -0.046* (0.020) | -0.13*** (0.012) |
| M45 | -0.0495*** (0.00522) | 0.0064 (0.0075) | -0.089*** (0.0090) | -0.038* (0.015) | -0.11*** (0.011) | -0.038 (0.020) | -0.13*** (0.013) |
| M46 | -0.0449*** (0.00529) | 0.010 (0.0077) | -0.089*** (0.0089) | -0.043** (0.015) | -0.11*** (0.011) | -0.039* (0.019) | -0.13*** (0.013) |
| M47 | -0.0426*** (0.00525) | 0.010 (0.0077) | -0.091*** (0.0090) | -0.043** (0.016) | -0.11*** (0.011) | -0.064** (0.020) | -0.13*** (0.012) |
| M48 | -0.0392*** (0.00528) | 0.014 (0.0077) | -0.086*** (0.0093) | -0.030 (0.015) | -0.11*** (0.011) | -0.074** (0.023) | -0.12*** (0.013) |
| Gap 4 | | 0 (.) | -0.094*** (0.016) | 0 (.) | -0.11*** (0.016) | 0 (.) | -0.11*** (0.017) |
| M49 | -0.0407*** (0.00532) | 0.0065 (0.0078) | -0.091*** (0.0091) | -0.029* (0.015) | -0.12*** (0.011) | -0.084*** (0.022) | -0.13*** (0.013) |
| M50 | -0.0447*** (0.00539) | 0.0063 (0.0079) | -0.090*** (0.0093) | -0.034* (0.015) | -0.12*** (0.011) | -0.077*** (0.019) | -0.13*** (0.013) |
| M51 | -0.0479*** (0.00559) | 0.0061 (0.0081) | -0.083*** (0.0093) | -0.027 (0.015) | -0.11*** (0.011) | -0.076*** (0.019) | -0.12*** (0.013) |
| M52 | -0.0484*** (0.00549) | 0.0054 (0.0080) | -0.086*** (0.0095) | -0.029* (0.015) | -0.12*** (0.012) | -0.074*** (0.020) | -0.13*** (0.014) |
| M53 | -0.0444*** (0.00553) | 0.0077 (0.0082) | -0.090*** (0.011) | -0.056** (0.021) | -0.11*** (0.012) | -0.055** (0.019) | -0.13*** (0.015) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|----------------------|----------------------|----------------------|---------------------|---------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M54 | -0.0480*** (0.00562) | 0.010 (0.0080) | -0.091*** (0.011) | -0.050** (0.016) | -0.11*** (0.013) | -0.072** (0.027) | -0.13*** (0.015) |
| M55 | -0.0475*** (0.00582) | 0.011 (0.0082) | -0.096*** (0.011) | -0.055** (0.017) | -0.12*** (0.013) | -0.047* (0.023) | -0.14*** (0.016) |
| M56 | -0.0451*** (0.00576) | 0.0087 (0.0085) | -0.096*** (0.011) | -0.057** (0.018) | -0.12*** (0.014) | -0.040 (0.025) | -0.14*** (0.016) |
| M57 | -0.0541*** (0.00590) | 0.0012 (0.0086) | -0.095*** (0.011) | -0.064*** (0.019) | -0.11*** (0.013) | -0.048 (0.026) | -0.13*** (0.015) |
| M58 | -0.0467*** (0.00593) | 0.0043 (0.0087) | -0.097*** (0.012) | -0.059** (0.019) | -0.12*** (0.014) | -0.070* (0.032) | -0.13*** (0.016) |
| M59 | -0.0424*** (0.00593) | 0.0029 (0.0085) | -0.10*** (0.012) | -0.053** (0.018) | -0.13*** (0.015) | -0.084* (0.038) | -0.14*** (0.016) |
| M60 | -0.0388*** (0.00597) | 0.012 (0.0086) | -0.100*** (0.012) | -0.041* (0.018) | -0.13*** (0.015) | -0.098** (0.037) | -0.14*** (0.016) |
| Gap 5 | | 0 (.) | -0.099*** (0.019) | 0 (.) | -0.11*** (0.019) | 0 (.) | -0.12*** (0.020) |
| M61 | -0.0410*** (0.00612) | 0.0096 (0.0089) | -0.092*** (0.012) | -0.021 (0.018) | -0.13*** (0.014) | -0.065* (0.027) | -0.15*** (0.017) |
| M62 | -0.0416*** (0.00617) | 0.0095 (0.0088) | -0.093*** (0.012) | -0.029 (0.018) | -0.13*** (0.015) | -0.060* (0.028) | -0.15*** (0.017) |
| M63 | -0.0450*** (0.00625) | 0.0071 (0.0089) | -0.095*** (0.012) | -0.027 (0.018) | -0.13*** (0.015) | -0.051 (0.028) | -0.16*** (0.017) |
| M64 | -0.0505*** (0.00629) | 0.0042 (0.0091) | -0.097*** (0.012) | -0.027 (0.018) | -0.14*** (0.016) | -0.065* (0.031) | -0.16*** (0.018) |
| M65 | -0.0472*** (0.00633) | 0.0046 (0.0092) | -0.093*** (0.012) | -0.018 (0.017) | -0.14*** (0.016) | -0.051 (0.026) | -0.17*** (0.019) |
| M66 | -0.0468*** (0.00637) | 0.0043 (0.0092) | -0.084*** (0.012) | -0.031 (0.018) | -0.12*** (0.016) | -0.041 (0.028) | -0.14*** (0.019) |
| M67 | -0.0521*** (0.00649) | -0.00022 (0.0095) | -0.071*** (0.013) | -0.018 (0.019) | -0.10*** (0.016) | -0.023 (0.026) | -0.13*** (0.019) |
| M68 | -0.0525*** (0.00655) | 0.0012 (0.0095) | -0.080*** (0.013) | -0.024 (0.019) | -0.11*** (0.017) | -0.037 (0.031) | -0.14*** (0.019) |
| M69 | -0.0548*** (0.00668) | -0.0036 (0.0099) | -0.072*** (0.013) | -0.022 (0.018) | -0.10*** (0.017) | -0.046 (0.032) | -0.12*** (0.020) |
| M70 | -0.0527*** (0.00669) | -0.00044 (0.0099) | -0.080*** (0.013) | -0.039* (0.019) | -0.11*** (0.018) | -0.076* (0.030) | -0.12*** (0.021) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|---------------------|----------------------|---------------------|----------------------|---------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M71 | -0.0455*** (0.00677) | 0.0052 (0.0097) | -0.090*** (0.014) | -0.034 (0.019) | -0.13*** (0.018) | -0.083** (0.030) | -0.14*** (0.022) |
| M72 | -0.0439*** (0.00687) | 0.0022 (0.0097) | -0.10*** (0.013) | -0.047* (0.019) | -0.14*** (0.018) | -0.098** (0.034) | -0.15*** (0.021) |
| Gap 6 | | 0 (.) | -0.085** (0.029) | 0 (.) | -0.10*** (0.029) | 0 (.) | -0.11*** (0.030) |
| M73 | -0.0432*** (0.00695) | 0.0100 (0.0098) | -0.095*** (0.013) | -0.040* (0.019) | -0.13*** (0.017) | -0.083** (0.030) | -0.15*** (0.020) |
| M74 | -0.0482*** (0.00703) | 0.0022 (0.010) | -0.10*** (0.014) | -0.042* (0.019) | -0.15*** (0.019) | -0.13*** (0.033) | -0.15*** (0.023) |
| M75 | -0.0458*** (0.00710) | 0.0076 (0.010) | -0.077*** (0.014) | -0.026 (0.019) | -0.12*** (0.019) | -0.096** (0.031) | -0.12*** (0.024) |
| M76 | -0.0537*** (0.00728) | 0.0022 (0.010) | -0.066*** (0.015) | -0.0071 (0.022) | -0.11*** (0.021) | -0.080* (0.033) | -0.12*** (0.026) |
| M77 | -0.0510*** (0.00735) | -0.0026 (0.011) | -0.067*** (0.016) | -0.0074 (0.023) | -0.12*** (0.022) | -0.057 (0.035) | -0.14*** (0.027) |
| M78 | -0.0532*** (0.00733) | -0.00018 (0.010) | -0.073*** (0.016) | -0.029 (0.022) | -0.11*** (0.021) | -0.043 (0.033) | -0.14*** (0.027) |
| M79 | -0.0530*** (0.00742) | 0.0032 (0.010) | -0.077*** (0.016) | -0.030 (0.022) | -0.12*** (0.021) | -0.057 (0.031) | -0.14*** (0.026) |
| M80 | -0.0570*** (0.00761) | -0.0045 (0.011) | -0.075*** (0.015) | -0.039 (0.022) | -0.10*** (0.021) | -0.043 (0.035) | -0.13*** (0.026) |
| M81 | -0.0539*** (0.00772) | -0.0054 (0.011) | -0.080*** (0.016) | -0.054* (0.023) | -0.095*** (0.023) | -0.045 (0.038) | -0.12*** (0.029) |
| M82 | -0.0546*** (0.00786) | -0.0033 (0.011) | -0.083*** (0.017) | -0.055** (0.021) | -0.10*** (0.026) | -0.12* (0.045) | -0.091** (0.031) |
| M83 | -0.0511*** (0.00759) | 0.0014 (0.011) | -0.091*** (0.017) | -0.056* (0.024) | -0.12*** (0.024) | -0.099* (0.044) | -0.12*** (0.028) |
| M84 | -0.0445*** (0.00752) | 0.0057 (0.010) | -0.11*** (0.019) | -0.051 (0.030) | -0.15*** (0.025) | -0.13** (0.043) | -0.16*** (0.030) |
| Gap 7 | | 0 (.) | -0.14 (0.10) | 0 (.) | -0.16 (0.10) | 0 (.) | -0.16 (0.10) |
| M85 | -0.0468*** (0.00774) | 0.0039 (0.011) | -0.11*** (0.021) | -0.068* (0.033) | -0.14*** (0.025) | -0.12** (0.045) | -0.15*** (0.029) |
| M86 | -0.0502*** (0.00788) | -0.0041 (0.011) | -0.11*** (0.024) | -0.068 (0.036) | -0.15*** (0.032) | -0.12* (0.047) | -0.16*** (0.042) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-------------------------|--------------------|---------------------|--------------------|---------------------|--------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M87 | -0.0419*** (0.00820) | 0.0017 (0.012) | -0.076** (0.023) | -0.031 (0.034) | -0.11*** (0.031) | -0.11* (0.046) | -0.11** (0.040) |
| M88 | -0.0448*** (0.00847) | 0.013 (0.012) | -0.070** (0.023) | -0.025 (0.029) | -0.11** (0.035) | -0.030 (0.049) | -0.16*** (0.048) |
| M89 | -0.0408*** (0.00861) | 0.0083 (0.013) | -0.050* (0.022) | -0.011 (0.027) | -0.086* (0.035) | -0.0091 (0.051) | -0.14** (0.046) |
| M90 | -0.0499*** (0.00875) | 0.0016 (0.013) | -0.053* (0.023) | -0.017 (0.030) | -0.083* (0.036) | -0.023 (0.053) | -0.12* (0.049) |
| M91 | -0.0641*** (0.00922) | -0.0070 (0.013) | -0.073** (0.024) | -0.058* (0.029) | -0.068 (0.039) | -0.038 (0.054) | -0.083 (0.056) |
| M92 | -0.0707*** (0.00963) | -0.022 (0.014) | -0.068** (0.024) | -0.060* (0.031) | -0.049 (0.038) | -0.015 (0.056) | -0.069 (0.052) |
| M93 | -0.0597*** (0.00963) | -0.016 (0.014) | -0.067* (0.027) | -0.059 (0.033) | -0.045 (0.043) | 0.023 (0.065) | -0.10 (0.055) |
| M94 | -0.0584*** (0.00963) | -0.017 (0.013) | -0.069* (0.029) | -0.061 (0.038) | -0.045 (0.044) | -0.020 (0.070) | -0.055 (0.050) |
| M95 | -0.0600*** (0.00994) | -0.012 (0.013) | -0.062* (0.028) | -0.031 (0.034) | -0.086 (0.046) | -0.10 (0.073) | -0.050 (0.054) |
| M96 | -0.0466*** (0.0104) | -0.0020 (0.015) | -0.019 (0.029) | 0.0084 (0.034) | -0.035 (0.055) | -0.069 (0.10) | 0.0012 (0.055) |
| Gap 8 | | 0 (.) | -0.38*** (0.020) | 0 (.) | -0.40*** (0.021) | 0 (.) | -0.41*** (0.021) |
| M97 | -0.0342** (0.0107) | 0.015 (0.015) | -0.030 (0.030) | 0.00095 (0.035) | -0.054 (0.060) | -0.013 (0.10) | -0.080 (0.065) |
| M98 | -0.0499*** (0.0110) | -0.0077 (0.016) | -0.018 (0.029) | 0.031 (0.031) | -0.12 (0.073) | -0.019 (0.11) | -0.22** (0.069) |
| M99 | -0.0491*** (0.0111) | -0.0077 (0.017) | -0.011 (0.037) | 0.026 (0.039) | -0.055 (0.093) | -0.041 (0.13) | -0.039 (0.077) |
| M100 | -0.0525*** (0.0122) | -0.0084 (0.017) | -0.0080 (0.042) | 0.015 (0.049) | 0.0026 (0.069) | 0.061 (0.090) | -0.057 (0.10) |
| M101 | -0.0421*** (0.0127) | -0.012 (0.020) | -0.018 (0.050) | 0.018 (0.057) | -0.070 (0.087) | -0.026 (0.10) | -0.20*** (0.011) |
| M102 | -0.0521*** (0.0145) | -0.0087 (0.022) | -0.11 (0.061) | -0.077 (0.072) | -0.15 (0.078) | -0.12 (0.095) | -0.16*** (0.011) |
| M103 | -0.0385* (0.0191) | 0.018 (0.035) | -0.11 (0.068) | -0.078 (0.080) | -0.15 (0.099) | -0.18 (0.098) | 0.15*** (0.011) |

Table H.9: Event-Study Estimates: Selection Into Challenges

| | (1) All | (2) One | (3) Two+ | (4) Two | (5) Three+ | (6) Three | (7) Four+ |
|--|-----------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| Dependent Variable: Ln monthly electricity use | | | | | | | |
| M104 | 0.0224 (0.0418) | -0.021 (0.032) | 0.14 (0.097) | 0.097 (0.099) | 0.33*** (0.010) | 0 (.) | 0.32*** (0.011) |
| M105 | 0.0422 (0.0430) | 0.024 (0.054) | 0.030 (0.15) | -0.070 (0.12) | 0.40*** (0.010) | 0 (.) | 0.39*** (0.011) |
| M106 | 0.0797 (0.0642) | 0.041 (0.16) | -0.076 (0.12) | -0.046 (0.12) | 0 (.) | 0 (.) | 0 (.) |
| M107 | 0.464*** (0.00609) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| M108 | 0 (0.00331) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) | 0 (.) |
| _cons | 6.775*** (0.00331) | 6.78*** (0.0037) | 6.77*** (0.0038) | 6.77*** (0.0040) | 6.76*** (0.0039) | 6.77*** (0.0041) | 6.76*** (0.0040) |
| <i>N</i> | | | | | | | |
| | 2130468 | 1466749 | 1517749 | 1250749 | 1332230 | 1167230 | 1230230 |

All specifications include individual and month-of-year fixed effects. Specification (1) is all participants pooled. (2) is households that undertake a single challenge only; (3) is households that undertake two or more challenges; (4) households that undertake two challenges only; (5) households undertaking three or more challenges; (6) three challenges only; (7) Four or more challenges. Standard errors are clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1

References

- BCH (2014). “BC Hydro News: Team Power Smart is changing, thanks to your feedback”. In: *Screenshot of news article available on request*.
- (2016). *BC Hydro Greenhouse Gas Intensities*. (Visited on 07/14/2018).
- BCStats (2016). *B.C. Regional Statistics: Population Estimates*. Available online at <http://www2.gov.bc.ca/gov/content/population-community/population/population-estimates> (accessed July 15, 2018). (Visited on 07/14/2018).
- British Columbia Utilities Commission (2017). *British Columbia Utilities Commission Inquiry Regarding Site C: Preliminary Report to the Government of British Columbia*. Tech. rep., pp. i–viii.
- Calonico, Sebastian, Matias D. Cattaneo, and Rocío Titiunik (2014). “Robust data-driven inference in the regression-discontinuity design”. In: *Stata Journal* 14.4, pp. 909–946.
- ECCC (2017). *Canadian Climate Normals 1981-2010. Climate ID:1108447*. Available online at <http://climate.weather.gc.ca> (accessed July 15, 2018). (Visited on 06/29/2017).
- EPA (2016). *EPA Fact Sheet: Social Cost of Carbon*. Tech. rep. December, pp. 1–5.
- EPA, California (2017). *California GHG Emission Inventory: California Greenhouse Gas Emissions for 2000 to 2015 - Trends of Emissions and Other Indicators*. Tech. rep. Air Resources Board, pp. 1–17.

- Lee, David S. and Thomas Lemieux (2010). “Regression Discontinuity Designs in Economics”. In: *Journal of Economic Literature* q90-0, pp. 281–355. DOI: [10.1257/jel.48.2.281](https://doi.org/10.1257/jel.48.2.281).
- McCrary, Justin (2008). “Manipulation of the running variable in the regression discontinuity design: A density test”. In: *Journal of Econometrics* 142.2, pp. 698–714. ISSN: 03044076. DOI: [10.1016/j.jeconom.2007.05.005](https://doi.org/10.1016/j.jeconom.2007.05.005).
- Schivley, Greg, Inês Azevedo, and Constantine Samaras (2018). “Assessing the evolution of power sector carbon intensity in the United States”. In: *Environmental Research Letters* 13.6. ISSN: 17489326. DOI: [10.1088/1748-9326/aabe9d](https://doi.org/10.1088/1748-9326/aabe9d).