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**Center for Sustainable Energy Systems CSE**

# ASSESSING THE IMPACT OF GOAL SETTING AND PERSONALIZED FEEDBACK ON ENERGY SAVING BEHAVIORS ST. POLYCARP VILLAGE


**Final Report by:**

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## Table of Contents



## Table of Figures

## Executive Summary

St. Polycarp Village is an affordable housing residency in Somerville, MA. The buildings are high efficiency, with LEED certification, solar PV, a green roof, energy star appliances, and other features. Although the residents do not pay for heat, they do pay for electricity, and we sought to help them reduce their electricity consumption, adopting less energy-intensive everyday practices.

While the building has the potential to be very energy efficient, the presence of sustainability features does not necessarily mean that the projected amount of energy will be saved. For example, research has found that giving someone a potentially energy efficient programmable thermostat does not necessarily mean that they will save energy (Malinick, et al., 2012). Every day practices influence the way people use energy, because to accomplish the same everyday objective (for example cook dinner) comparable individuals may engage in practices that demand energy in a very different way. A lifestyle based on microwaving meals *v.* hold fashion cooking is an example of practices that involve very different amounts of energy consumption to provide for the same basic need. Marketing providing new social norms, increased mobility and the breach between social and familial networks can explain the ever-increasing adoption of energy demanding lifestyles. We performed an experiment with the residents of one of the buildings, comprising 24 apartments. We visited the site every week from July 12, 2013, to November 22, 2013, to read their electricity meters. The first eight weeks were used as a baseline of electricity consumption. During the second 8-week period, we mailed energy saving tips to half of the apartments every week. We continued to record their electricity consumption for 4 weeks after the end of the treatment, to determine if residents continued to follow the energy saving tips.

Results showed that cooling degree days, and the experimental group were significant predictors of energy consumption, and number of hours of daylight was not a significant predictor. Because the experimental group significantly predicts consumption during the baseline period, it appears that the two groups were significantly different from each other before implementation of the treatment and thus come from different populations. As a result, it is difficult to determine the effect of our treatment because we cannot directly compare the two groups.

It is possibly that a larger sample size would have yielded more comparable experimental groups, and thus allowed for a more reliable analysis of the effect of our treatment.

## Introduction

Convincing people to save energy can be extremely difficult. However, there are cognitive processes and heuristics that researchers can explore to encourage energy efficient decisions. The transtheoretical model (Norcross, 1992; Prochaska & DiClemente, 1983; & Prochaska, DiClemente) attempts to conceptualize the process of intentional behavioral change by placing individuals in one of four stages of the behavior change process based on a specific behavior. These stages are: pre-contemplation, contemplation, action, and maintenance. This theory could be applied to promoting and maintaining sustainable practices by changing existing energy intensive everyday habits. People in different stages of the transtheoretical model are characterized by how receptive they are to the idea of behavior change. Therefore, different strategies for enabling these changes will be more effective for some groups than for others (Prochaska, DiClemente, & Norcross, 1992). Motivation is viewed as an important component throughout the entire process of change. Thus, it should be possible to tailor the message to speak to people in different stages of intentional behavioral change, which could help them progress to the next stage (DiClemente, 2004).

People in the pre-contemplation stage lack both an awareness of a problem and recognition of the self as part of the problem (Prochaska, DiClemente, & Norcross, 1992). Our goal is for the subject to recognize their role and responsibility for energy consumption. We can do this by personalizing the risks of inaction and providing vivid information that inspires regret or excitement in relation to the problem. This draws on the availability heuristic, which makes people overestimate the importance of recent or vivid events because they are more readily available in a person's mind (Ashby, et al. 2010).

Feedback about energy usage and efficiency as a social norm can also be useful in raising people's awareness of the problem's existence, though the way the problem is framed can impact whether people will use more or less energy in response (Darby, 2006; Cialdini, 2007). Importantly, Cialdini (2007) also states that people are unaware of the effect social norms have on their behavior, which ensures that people in the pre-contemplation stage will not feel coerced. If people feel pressured into changing their behavior, it is likely that they will revert to their old behaviors once that pressure, such as the urging of friends or a motivational campaign, is removed (Prochaska, DiClemente, & Norcross, 1992).

The contemplation stage represents an awareness of the issue and stimulates thinking about behavior change, but without a commitment to do so. Interventions should focus on attitude change and providing concrete goals that make change seem attainable (Prochaska, DiClemente, & Norcross, 1992). When combined with energy use feedback, self-set goals and assigned goals help people save more energy than those with no specific goal (McCalley, 2006). Additional information about the problem, as well as continued feedback and demonstrated support from the community, can help people overcome their ambivalence towards adopting new behaviors. Social cognitive theory attributes this type of behavior change to the integration of outside information into one's personal viewpoint in a way that allows the individual to feel ownership of the behavior (McCalley, 2006, p. 1153). Attitude and behavior influence each other, and feeling like you are able to implement a certain change is crucial to this process. At this stage, it is important to make people think that they can and should be changing their behavior, and to help them plan these changes.

In the action stage, people have already decided to change their behavior and should be targeted with attempts to combine this intention with real behaviors, modifying existing behaviors or routines to initiate the change (Prochaska, DiClemente, & Norcross, 1992). A good way to do this is to make the initial actions easier, providing concrete steps for what to do and how to do it. We want people to build skills and make contextual changes, which will help them overcome barriers to behavior change and make them more likely to perform the desired behaviors. This can be accomplished by changing default options to the desired behavior. For example, in two natural experiments and two laboratory experiments, Pichert and Katsikopoulos (2008) demonstrated that people prefer a "green" power source over a non-sustainable source when it is the default choice or if there is no default selected; however, when the non-sustainable option is the default, more people chose that option. This is an example of the status quo bias, wherein people generally prefer to maintain the default option because it requires less effort and because it is the implicitly recommended course of action (Pichert & Katsikopoulous, 2008).

Information about available incentives or technology - including behavior change support systems - will provide individuals with more ways to turn their intentions into actions. Having people make plans for exactly when or how they will perform an action can also increase the likelihood that they will perform it (McCalley, 2006; Nickerson & Rogers, 2010). Reminders or prompts to perform a new behavior can have this effect as well (Ashby, et al., 2010).

Maintenance involves working to prevent relapse, and making the behavior change permanent. Several strategies used for the action stage may also be appropriate during the maintenance stage. It is essential to equip people with skills and social support that can help them prevent and recover from relapses. One factor is maintaining the self-perception that they are the kind of person they want to be, whether that is someone who has recovered from an addiction or has started saving energy (Prochaska, DiClemente, & Norcross, 1992). Social support can be implemented by making use of social norms—even if someone is having trouble conserving energy, they may still believe others are doing it and that it is the correct thing to do. It is also necessary to ensure that new behaviors become habits, so introducing people to new technology that can automate their energy savings or help them save without much effort will be effective (Houde & Todd, 2011). We want to make it as easy as possible for them to continue saving energy once they have begun to do so. Having people commit to following through with their behaviors can make them more likely to perform those behaviors in the future (Burn & Oskamp, 1986).

In planning an intervention for a residential building, we designed energy saving tips that could be distributed to residents who fell into each behavior change category. We used variations of the same tips for each stage, phrased in ways that would appeal to each group. For example, one tip we wrote involves unplugging the television when it is not in use, since it still uses power when it is turned off. The tailored message for the pre-contemplation group informed subjects of this problem and that they are wasting money by leaving their televisions plugged in, but without specifically instructing them to unplug their televisions. The contemplation group, however, would be more amenable to having their attitude changed. The message can contain social norms, saying that most people would approve of this energy saving measure, and suggesting that they could try a simple goal like unplugging the television a twice in the next week. The action group benefits from concrete instruction, so we suggested ways to make unplugging the

television easier to start doing: set an alarm to remind yourself, and unplug it when you turn it off for the night. Finally, the maintenance group should be given ways to consolidate habits and prevent relapse. Here, we suggested using an advanced power strip, which can prevent electronics from consuming electricity when not in use. We listed a website where subjects could purchase them for a discounted rate, and suggested using the power strip for multiple electronic devices and turning them all off by switching off the power strip. This builds on previous actions and makes habit-forming easier, simplifying the energy saving action.

Tailoring messages about energy savings to the different stages of behavior change means that no one will feel that they are being forced to do something they are not prepared to do, or that they are being chastised for not taking action sooner. These message strategies make suggestions that are attainable for each level of behavior change preparedness. Intrinsic motivation is more powerful than external motivation, and more resistant to relapses (Curry, Wagner, & Grothaus, 1990). Our goal is for people who are given these tips to identify with their goals and feel that these changes are what they themselves want to do, and not simply that someone is trying to convince them to alter their behavior. The different stages in the behavior change process are more susceptible to certain strategies because they represent different levels of readiness for change. To best apply the transtheoretical model of behavior change, and to provide the most useful strategies to people in the various stages, it is necessary to segment the chosen population by their level of change readiness. In a substance abuse context, this has been accomplished with a 32-item assessment, which asks participants to rate their agreement with statements like “I may be part of the problem, but I don't really think I am,” and “Anyone can talk about changing; I'm actually doing something about it” (McConaughy, et al., 1989).

The assessment has been adapted for other areas of behavior change such as weight loss (Prochaska, DiClemente, & Norcross, 1992), and could be similarly adapted to be relevant to energy usage (Table 1). Scoring this assessment would indicate which members of the sample are in which stages, and who will benefit most from different tailored tips. Applying the stages of change framework to energy savings tips involves using different strategies for each stage. This is illustrated in the way we worded messages that encourage turning down the heat at night or when no one is home. The tailored message for the pre-contemplation group informed subjects that heating and cooling can be up to about half of your utility bill, and that many people save money by turning the temperature down at night.

We did not specifically instruct them to turn down the heat, because at this stage people do not yet want to change their behavior. Pre-contemplation is about raising awareness of the problem and the fact that it is solvable, so vivid information is most helpful. The contemplation group, however, would be more amenable to having their attitude changed. The message can contain social norms, saying that most people would approve of this energy saving measure, and suggesting that they try a simple goal like turning down the thermostat 2-5° the next time they leave the house, and adding that many people think 3° is a good amount to reduce the temperature.

Table 1: Description of the four stages of the transtheoretical Model of Behavior Change

| Stage | Description | Strategies |
|---|---|---|
| Pre-contemplation | People in the pre-contemplation stage have no intention to change their behavior, and may have little to no awareness of the problem. | • Raise awareness of issue<br>• Personalize risks of inaction<br>• Provide vivid & personalized information inspiring fear or excitement<br>• Provide feedback related to energy use, with salient social norms |
| Contemplation | The contemplation stage is characterized by an awareness of the problem, and thinking about taking action but not yet being committed to doing so. | • Provide information<br>• Continue feedback<br>• Goal setting<br>• Provide social support |
| Action | People who are in the action stage are taking steps to change their behavior, environment, or experiences to overcome the problem. | • Help overcome barriers to behavior change<br>• Concrete tips on what to do and how to do it<br>• Provide information about new technology, services, and incentives<br>• Skill development<br>• Behavior change support systems, and social support |
| Maintenance | The maintenance stage involves forming new habits and maintaining the behavior change begun in the action stage. Relapse is common during the behavior change process, and people in the maintenance stage must attempt to avoid and recover from relapse. | • Provide skills to help prevent and recover from relapse<br>• Introduce new technology to help automate "good" behavior or be more efficient without much effort<br>• Behavior change support systems, and social support |

The action group benefits from concrete ways to make behavior change easy, so we suggested using the programmable features of their thermostat to automatically lower the temperature at night and when no one is home, as well as providing a link to a website with rebates for new Energy Star heating units. Finally, the maintenance group should be given ways to consolidate habits and prevent relapse. Here, it would be ideal to provide step-by-step instructions for programming a schedule into their thermostat, specific to their thermostat model.
This builds on previous actions and makes habit-forming easier, simplifying the energy saving action.
After a group of people has been segmented into these stages, the tips can be distributed accordingly. In this way, all subjects receive the same energy saving tips, but the information is tailored so that there will be less resistance to adopting the behaviors. After the information has been distributed, it is necessary to reassess the subjects' current stage of the behavior change process and determine if the tips did move them further along in the process of change.

We have not had the opportunity to empirically test our tips as described above, although this could be investigated in future studies. We were not able to segment our sample due to limited contact with participants, a limited sample size, and low return rates for previous surveys with this population.

Thus, we adapted these segmented tips to create more universal flyers, which were sent to the subjects by mail every week. These flyers were created such that some information from each one would appeal to people at each stage. With each mailing, we included a general information sheet about the program and two pages with different types of tips, such as lighting and heating. Each tip sheet included a few pieces of information about the energy consuming device, which could be the amount of energy or money that activity or device uses or ways that people find to save energy.

Below this, we included two concrete suggestions for ways to save. These had check boxes next to them, so participants could choose which of the energy saving methods they wanted to implement that week. One suggestion was generally easier than the other, and we suggested ways to automate the efficient behavior where possible. By including options of different difficulties, we hoped to take advantage of people's preference for the more moderate option (citation). We expected that people who were not as far along in the behavior change process would choose to do the easier option because it was much more reasonable than the difficult option, and the people in the action or maintenance stage would choose the difficult option because the other option was too simple and not aggressive enough.

We also included a relevant image, illustrating the device or action described on the flyer. For pictures that included people, we attempted to find pictures that depicted people with similar characteristics and in a similar environment to the target population, taking advantage of the trusted messenger effect (Ashby, et al., 2010). In accordance with findings about framing, we phrased the information in terms of waste prevented instead of savings earned, because people are more upset by losses than they are made happy by equivalently sized gains (Houde & Todd, 2011).

## Participants

The participants were residents of the St. Polycarp village apartment complex. The experiment was non-invasive and did not require interaction with the participants or changes to their normal routines. Although the residents could decide whether or not to act on the tips, all residents of the chosen building's 24 apartments were considered to be part of the study. One of the electricity meters was malfunctioning for much of the study period, and one apartment seems to have been unoccupied for about a third of the study, and these two units were excluded from the final analysis, leaving 22 apartments.

## Materials

The first contact with residents was a flyer describing our project, which we called the "St. Polycarp Energy Challenge." This flyer explained that we would be sending weekly tips to help the St. Polycarp residents save energy, and challenged the residents to implement these tips and become an example for their community (Figure 1)


**Figure 1: The Flyer**

We used social norms to encourage participation in the program, encouraging tenants to join in the efforts of the rest of the community, and also tried to make it seem like a competition or game. We told them to keep track of how many of the energy efficiency tips they were going to perform each week by checking off the tips and count up the checked boxes. We included descriptions of what the different "scores" meant, with 0-1 meaning they should read more about energy efficiency, and 4 meaning they were a "super energy saver".

The subsequent weekly mailings included a general information sheet about the program, very similar to the initial flyer, and two pages with different types of tips, such as lighting and heating. Each tip sheet included a few pieces of information about an energy consuming device or behavior, which could be the amount of energy or money that activity or device uses or ways that people find to save energy. In accordance with findings about framing, we phrased the information in terms of waste prevented instead of savings earned, because people are more upset by losses than they are made happy by equivalently sized gains (Houde & Todd, 2011). Below this, we included two concrete suggestions for ways to save. These had check boxes next to them, so participants could choose which of the energy saving methods they wanted to implement that week. One suggestion was generally easier than the other, and we suggested ways to automate the efficient behavior where possible. By including options of different difficulties, we hoped to take advantage of people's preference for the more moderate option We also expected that different levels of options would appeal to a wider range of people, instead of targeting just those who were extremely committed to saving energy. Each page of tips included a relevant image, illustrating the device or action described on the flyer. For pictures that featured people, we attempted to find pictures that depicted people with similar

characteristics and in a similar environment to the target population, taking advantage of the trusted messenger effect (Ashby, et al., 2010; Figure 2 – 3). Remaining tips are in the annex.


Figure 2: Example of a tip and challenge about lighting


Figure 3: Example of a tip and challenge about sustainable washing habits

## Procedure

We mailed a flyer describing the Energy Challenge to the residents and hung a copy of the flyer on a communal bulletin board a week before the first set of tips was mailed. The apartments were subsequently randomly divided into a treatment group and a control group. We continued to send tips to the treatment group once a week, and read the electricity meters for all apartments. We sent out 8 sets of tips, one for each week of the treatment period.

## Results

We used the trimean of the electricity consumption for each group because this is a more robust measure of central tendency than an average, and it is resistant to outliers. A Kolmogorov-Smirnov test on the baseline data was non-significant (K-S = .46, p = .982), indicating that the data were normally distributed. The same was true for the consumption during the treatment and post-treatment period (K-S = .905, p = .39). We then performed a regression analysis on the baseline data, with the experimental group, cooling degree days, and daylight hours as explanatory variables. We did not use heating degree days as an explanatory variable because heat was not included in the residents' electricity consumption. The model had a good overall fit with a high adjusted R2 of .82, and a Durbin-Watson statistic of d = 1.75 which means that there was no autocorrelation in the data. Cooling degree days ($\beta$ = .433, p = .02) and the experimental group variable ($\beta$ = .77, p < .001) were significant predictors of consumption, and number of hours of daylight was not a significant predictor. Because the experimental group significantly predicts consumption during the baseline period, it appears that the two groups were significantly different from each other before we implemented the treatment and thus come from different populations. As a result, it is difficult to determine the effect of our treatment because we cannot directly compare the two groups. As shown in the graph below, the treatment group initially used more electricity, but their consumption decreased to levels that are similar to the control group after the treatment began. However, because the two groups seem to be from populations with different characteristics, we cannot determine that this decrease in consumption was caused by our treatment and not by preexisting differences (Figure 4).

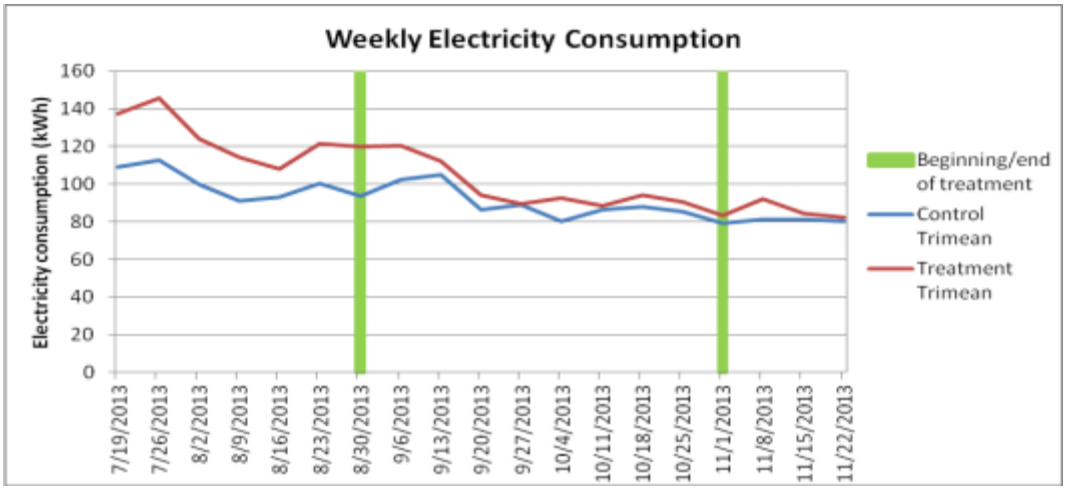


Figure 4: Average weekly energy consumption for treatment and control

When we ran a regression analysis on the treatment and post-treatment period, the model also had a good overall fit (adjusted R2 = .83) and the Durbin-Watson statistic indicated that there was no autocorrelation (d = 1.96). Experimental group ($\beta$ = .33, p = .001) and cooling degree days ($\beta$ = .89, p < .001) were significant predictors again, and daylight hours was not a significant predictor ($\beta$ = -.34, p = .85). Even though group membership was a significant predictor of consumption during and after the treatment, we cannot draw any conclusions about whether our treatment caused the difference. This is due to the initial difference between groups that was found above.

## Discussion

We could not conclude that our treatment had an effect on the electricity consumption of the residents. It is possibly that a larger sample size would have yielded more comparable experimental groups, and thus allowed for a more reliable analysis of the effect of our treatment. For a study of this type it may be beneficial to perform randomization based upon actual electricity consumption data instead of randomizing apartments, as it was apparent that the two groups had very different electricity consumption lifestyles.

Importantly, many of the tips suggested energy saving measures that would not impact the residents' electricity consumption, but would still save energy. For example, one week's tips involved implementing nighttime setbacks with the programmable thermostats that were in the apartments. While this would save energy, heating was not included the tenants' electricity bill. There is also no way to know if the tenants actually read the tips or simply discarded them. Based on the population of the area, it is also possible that some of the residents in the building were not native English speakers and may have had difficulty understanding the tips.

Another limitation of this study is the fact that most tenants were not excessive users of electricity and may not have been able to significantly reduce their consumption from their initial levels. The building's efficiency and energy saving appliances likely contributed to this, making residents think that they are already doing enough to save energy. However, it is important to continue testing similar programs in larger populations and less efficient buildings, where these tips may have a larger impact.

## Future Directions

For future research it will be necessary to do a survey of the participants before and after the experiment, because electricity consumption is not a good proxy for changes in lifestyle, which can happen without any significant impact on energy consumption. It may also be beneficial to examine the specific effect of message framing upon behavior. Rothman, et.al., (2006) notes that gain-framed messages are better for targeting preventative behaviors (e.g., installing CFL bulbs, insulating pipes) while loss-framed messages are more appropriate for detection behaviors (e.g., determining areas of energy consumption that are a problem). It may be that tailoring messages to consumers using gain or loss framed messages will stimulate behavioral change. For example, telling participants that by replacing two incandescent light bulbs with CFL bulbs they can save $63.00 per year on their electricity bill is an example of a gain-framed message that may impact a specific preventative behavior (data drawn from Energy Star CFL savings calculator). The addition, using visual aids has been shown to increase the effectiveness of both gain and loss-

framed messages in health domains (Garcia-Retamero & Cokely, 2011). Adding effective visual aids (e.g., simplified graphs depicting savings for changing a behavior versus baseline data when behavior is not changed) may aid consumers to adopt "healthy" behaviors with regards to energy consumption.

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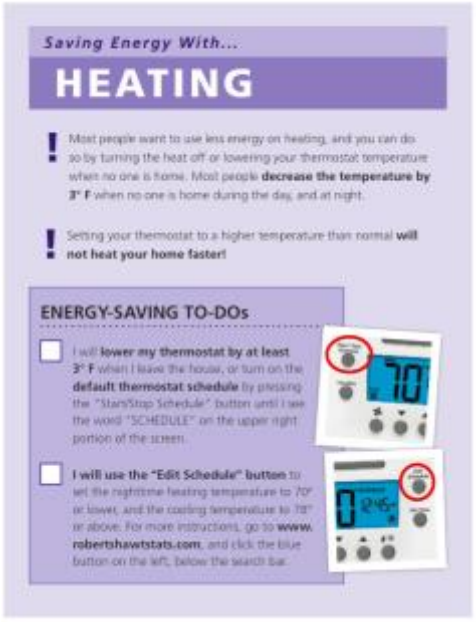


**Figure 5:** Example of a tip and challenge about saving energy through programming the energy saving features of thermostats


**Figure 6:** Example of a tip and challenge about saving energy while washing the dishes


**Figure 7:** Example of a tip and challenge about saving energy with refrigerators


**Figure 8:** Example of a tip and challenge about saving energy through lighting

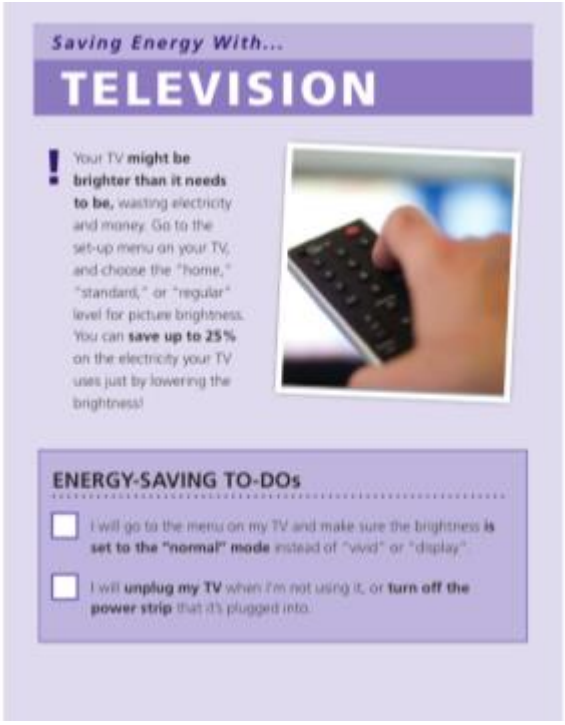


**Figure 9:** Example of a tip and challenge about saving energy with electronic equipment


**Figure 10:** Example of a tip and challenge about saving energy by weather striping your home


**Figure 11:** Example of tip and challenge about saving energy with electronic equipment


**Figure 12:** Example of a tip and challenge about saving energy with power strips


**Figure 13:** Example of a tip and challenge about saving energy with controlling light and heat

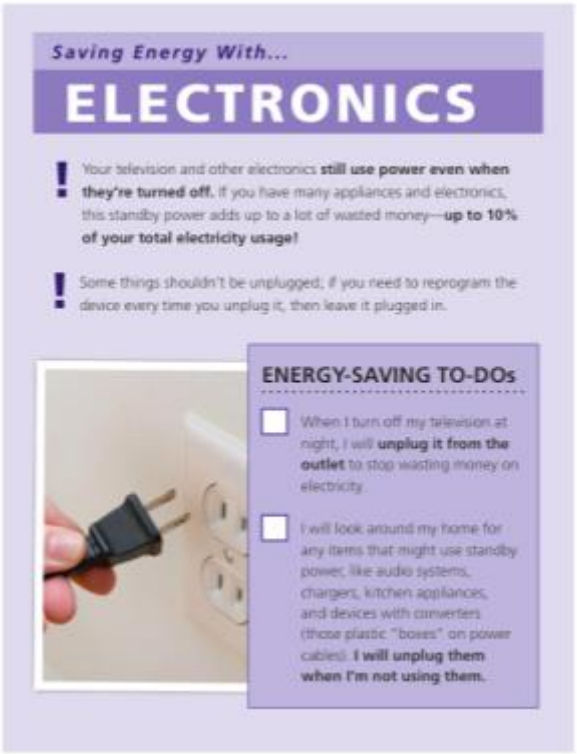


**Figure 14:** Example of a tip and challenge about saving energy with electronics


**Figure 15:** Example of a tip and challenge about saving energy while doing the laundry