THERMOSTAT BEHAVIORS AND ENERGY CONSUMPTION HABITS IN RESIDENCE HALLS AT TEXAS STATE UNIVERSITY

by

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DEDICATION

To my mother and father,

Words cannot express how thankful I am for the opportunities you have provided me. Your strength, courage, and love constantly motivate me to be the best I can be. I love you both more than you will ever know!

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LIST OF ABBREVIATIONS

Abbreviation	Description
°F	Degrees Fahrenheit
CBSM	Community-Based Social Marketing
DOE	United States Department of Energy
EPA	United States Environmental Protection Agency
DHRL	Department of Housing and Residential Life
kW	Kilowatts
kWh	Kilowatts per hour
NEP	New Ecological Paradigm
THECB	Texas Higher Education Coordination Board

CHAPTER I.

INTRODUCTION

The threat of climate change necessitates a growing movement to conserve resources and reduce greenhouse gas emissions. According to the U.S Department of Energy (DOE), buildings consume 40% of all energy used in the United States; of the country's contribution to nearly one-fifth of the world's carbon dioxide emissions, 8% comes from these buildings. The U.S. boasts over 7,000 higher education institutions that annually spend over $14 billion on energy costs (U.S. DOE; U.S. Department of Education). Not only do these institutions contribute to a large environmental footprint, but are also well-suited to influence sustainable behaviors among younger generations.

The city of San Marcos, located in Central Texas and home to Texas State University (Texas State), holds the 2014 title for fastest growing city in the country (Theis 2014). Similarly, the University has also experienced rapid growth. According to *Texas State Student Enrollment Data* (2014), enrollment increased by over 13,000 students between 2001 and 2014. At the beginning of the fall 2014 semester, the University reached a record-setting enrollment of 36,790 students (Blaschke 2014). Nearly 20% of these students live on-campus. A growing student body drives the need for more classroom and living space, which consequently augments the University's energy and carbon footprints. At the same time however, a growing vulnerability to climate change calls for a stronger movement to conserve resources and reduce greenhouse gas emissions. Higher education institutions can positively influence sustainable behaviors of incoming students using technological and logistical protocols coupled with outreach for end-users. Targeted efforts, including increasing awareness and education, may not only reduce energy usage, but also decrease carbon dioxide emissions, water consumption, and financial expenses, while impacting behaviors over the long-term (Parece et al. 2012; Pallak & Cummings 1976; Katzey & Johnson 1984).

Buildings use nearly 40% of all primary energy in the nation, the highest of any consumer type (U.S. Energy Information Administration 2014). In 2001, the Texas legislature mandated energy efficiency standards for public buildings to meet U.S. Clean Air Act requirements. Requirements for public universities to reduce annual electricity consumption by 5% began in 2011 and must continue until 2021 (U.S. DOE 2014). So far, technological upgrades have helped Texas State meet this requirement. However, technology depends, to some degree, upon human behavior, since humans can significantly strengthen or weaken the effectiveness of technology through adoption and maintenance (Kaplowitz et al. 2012; Lutzenhiser 1993; Parece et al. 2012). High costs associated with retrofitting older buildings also limit the feasibility of technology adoption. Thus, education and outreach programs focused on student, staff, and faculty energy-related actions and behaviors will play an increasingly important role in the University’s future.

The majority of the literature concerning energy conservation behavior covers the residential sector. Some studies discuss university campuses, but focus on building type (science laboratories, office/administration buildings, classrooms, residence halls, libraries) and target populations (faculty and staff and students). Little to no literature focuses on room temperature behavior among students living in university housing. Though many residential halls restrict thermostat control ranges (if thermostats are even installed in individual rooms), incorrect management can still result in energy waste. And in thermostats that are not restricted, the potential for even larger amounts of energy waste exists. For example, setting the temperature to 73°F rather than 78°F during warmer months may use up to 50% more energy (Vanderbilt 2013).

High rates of discrepancy between self-reported energy conservation behaviors and behavioral observations in residential energy conservation programs are repeatedly identified throughout the literature (Bickman 1972; Deutscher 1973; Robinson & Frisch 1975; Wicker 1969). This research seeks to measure the action-value gap of energy consumption behaviors among students living in university housing before and after a 12-day passive, educational outreach program. Specifically, it focuses on comparing reported and actual behaviors associated with thermostat controls, but also includes broader energy usage behaviors. Texas State should consider the outreach campaign and its effects to see if instituting a permanent program is worthwhile.

CHAPTER II.

LITERATURE REVIEW & GAPS

ENERGY CONSERVATION

Research on energy consumption and conservation behaviors in residential households outnumbers studies focusing on higher education settings (Arpan, Opel, & Lu 2013; Croucher 2011; Geller 1981; Goldblatt, Hartmann, & Dürrenberger 2005; Hutton & McNeil 1981; Schultz et al. 2007). Several factors differentiate these two spheres. Universities usually lack the ability to provide feedback, such as an energy or water bill or real-time monitoring to residents on campus (Emeakaroha, Ang, & Yan 2012; Peterson et al. 2007). Further, university students do not consciously bear the financial responsibility of energy usage, nor are fluctuations in energy bills knowingly reflected in students' tuition and fees (Chan et al. 2012). McMakin, Malone, and Lundgren (2002) studied the impacts of energy conservation campaigns in U.S. military housing to understand the lack of financial incentives on related behaviors. Participants divided into two different campaigns stated the desire to set good examples for their children and to maintain comfortable homes influenced behavior— neither of which is directly applicable to university students living on-campus.

A limited sense of ownership over both office space in academic buildings and living space in residential halls also presents a challenge. Occupants do not own the room, and thus may not feel a personal investment to minimize energy use, especially given the yearly turnover rates within residence halls (Chan et al. 2012; Cole & Fiselman 2013). Despite these obstacles, higher education institutions serve as productive grounds for social diffusion; that is, an individual adopting a new behavior can influence change as it spreads across one's social network (Rogers 1995). Studies as early as the 1980's suggest that community leaders who select college students modeling a desired behavior increases adherence to the desired behavior, through this process of social diffusion (Aronson & O'Leary 1982; Gardner & Stern 2002; Winter & Koger 2004).

With respect to universities, the literature typically explores the attitudes of faculty, staff, and/or students and the institutional obstacles inhibiting increased adoption of energy conservation behaviors. These studies commonly use a process called Community-Based Social Marketing, creating a targeted energy conservation outreach pilot program to decrease overall energy consumption. Frequent research methods include surveys, in-depth interviews, and focus groups to measure attitudes and beliefs related to energy consumption (Chan et al. 2012; Kaplowitz et al. 2012; Marcell, Ageyman, & Rappaport 2004; Marans & Edelstein 2010; McClelland & Cook 1980).

SOCIAL NORMS & RELATED THEORIES

According to social norm theory, humans are socially influenced by interactions with peers. Humans tend to base their own behavior off behaviors of influential individuals and the perceived degree of social acceptance associated with that behavior (Cialdini 2003; Corral-Verdugo & Frías-Armenta 2006; Kurz et al 2005; Parece et al 2012; Van Raaij & Verhallen 1983; Schultz et al. 2007). In other words, norms guide and influence behavior through cues that suggest what is appropriate and desirable (Delmas et al. 2013). Comparative feedback (sending signals and information comparing one's own behavior to their peers), competitions, and goal-setting motivations are common methods to influence norms.

The theory of normative conduct, however, states that norms are only likely to directly influence behaviors if they become the focus of attention and part of consciousness (Cialdini et al. 2006; Cialdini, Reno, & Kallgren 1991). Cialdini et al. (1991) use two types of social norms to describe this theory, descriptive norms and injunctive norms. A descriptive norm is the perception of what most people do within a given context (Cialdini et al. 1991; Schultz et al. 2007; Arpan et al. 2013). An injunctive norm is the perception of what society either approves or disapproves (Cialdini et al. 1991; Schultz et al. 2007). Both types of norms motivate human action and behavior. According to Goldstein et al. (2004) and Schultz et al. (2007), the norm more dominant in an individual's consciousness is the one that will impact behavior the most.

Many studies, especially university campaigns to reduce binge-drinking behaviors, assess the effectiveness of descriptive and injunctive norms using a social norms marketing approach. While a portion of these campaigns proved successful, a number actually increased the undesired behavior (Schultz et al. 2007). Therefore, the use of descriptive norms, in addition to injunctive norms, may prevent this boomerang effect in which recipients engage in behaviors opposite the message campaign (Schultz et al. 2007; Perkins, Haines, & Rice 2005).

Several factors affect norm adherence, including an individual's perceived social identity and the level of perceived similarity between themselves and others (Burnkrant & Cousineau 1975; Festinger 1954; Goldstein et al. 2008; Moschis 1976). A variety of motivations and barriers also may impact a norm's effectiveness.

Barriers

Both residential and university energy consumption studies identify many barriers that limit an individual's perceived ability to engage in conservation behaviors. Some of these intertwining barriers include, but are not limited to, perception, structural challenges, the knowledge gap, attitudes and motivations, the action-value gap, socio-psychological factors, and physical/institutional barriers.

Energy as a concept is difficult to understand because one cannot physically see what is being consumed, often referred to as the "invisibility" factor; a problem especially pronounced in residential halls (Aronoff et al. 2013). This out-of-sight, out-of-mind concept, coupled with the widely held Western-view that energy is not only a necessity, but also a commodity, helps explain why conservation efforts are often inhibited (Aronoff et al. 2013). For example, according to Kim and Shcherbakova (2011), the proportion of annual household income spent on purchasing a car (when considering annual payments) versus electricity is about the same, yet people spend considerably more time contemplating the automobile purchase.

Furthermore, conservation behaviors must be embraced without the perception that these actions compromise ease and productivity of everyday life. Perception (or rather misperception) of energy is often structurally viewed as failure of the market. Individuals do not possess the proper knowledge to engage in conservation behaviors, and acquisition of that information is costly (time and resources) (DeYoung, 2000, Hungerford & Volk 1990; Schultz, 2002; Delmas et al. 2013). Making this information accessible is an important piece to prompt conservation behaviors.

Bridging the knowledge gap (what, why, and how) is another important barrier to address in the successful adoption of sustainable behavior (Abrahamse et al. 2007; Bradford & Fraser 2008; De Young 1993; Goldblatt et al. 2005; Kannan & Boie 2003; Kehbila et al. 2009; Wright 2008).

Attitudes and motivations tie closely together in influencing behavior. An individual's perception of personal responsibility versus what others are or are not doing is an example of a lack of social pressure (Stern et al. 1995; Marcel et al. 2004; Aronoff et al. 2013). Similarly, an individual not responsible for paying the energy bill, may be less inclined to engage in conservation (Kaplowitz et al. 2012 and Parece et al. 2012). Inconvenience, forgetfulness, and a lack of communication or miscommunication also affect efforts to increase engagement (Aronoff et al. 2013).

Additionally, the action-value gap theory presents a challenge, stating that an individual who claims favorable values, knowledge, and/or attitudes may not actually exhibit behaviors that fall in line with those claims (Kaplowitz et al. 2012; Kollmuss & Agyeman 2012; Marcell et al. 2004; Owens & Driffill 2008; Van Raaij & Verhallen 1983). In other words, reported beliefs and actions may not actually reflect everyday behaviors. While expressing environmental concern and engaging in rudimentary conservation actions (i.e. turning off the TV or lights when leaving) increasingly appears in today's society, few are willing to take part in behaviors that alter their lifestyle. Thus, these common-place actions are merely "tokenistic" and may not be indicative of environmental concern (Blake 1999).

Similarly, according to the theory of planned behavior, attitudes, social norms, and perceived control (or some combination of these factors) usually determine behavior

(Ajzen 1991). This is partly due to a confluence of other barriers, such as socio-psychological factors (i.e. values, social norms, altruism, and beliefs), forgetfulness, and structural barriers (Aronoff et al. 2013; Clark et al. 2003; Marcell et al. 2004; Kaplowitz et al. 2012; Stern et al. 1995).

Institutional barriers, such as physical building conditions and technological features, also affect the adoption of energy conservation behaviors. For example, buildings with better cross-ventilation and good insulation may increase or decrease the need or display of certain behaviors. Climate and weather related factors, such as heating degree-days, hours of sunlight, cloudiness rating, relative humidity, and outside temperature can determine how (and how much) people consume energy (McClelland & Cook 1980). Other personal habits can also influence behaviors, such as the type of clothing worn – though this may actually relate to willingness to change behavior (Marans & Edelstein 2009).

Motivations

A combination of internal (individual and psychological) and external factors and motivations (institutional, economic, social, and culture) also influence energy conservation behaviors (Kaplowitz et al. 2012). As discussed, behavior adoptability increases as cost, time, effort, money, and other resources perceived necessary decrease (Abrahamse et al. 2007; Barr et al. 2005; Bradford & Fraser 2008). Thus, the likelihood of participation increases if the perceived "cost" is low (Kollmus & Ageyman 2002). While theory holds that education is powerful enough to help drive these behaviors, more recent studies indicate that feedback may motivate more effectively (Delmas et al. 2013).

Regular feedback helps close the knowledge gap through the dissemination of educational information, which increases awareness (Benders et al. 2006; Löfström & Palm 2006; Kaplowitz et al. 2012; Matthew et al. 2007). Providing visual prompts via feedback, be it real time or a comparison with past usage, is generally viewed as one of the most effective means to influence energy conservation behaviors, especially in literature based on community behavior social marketing; Parece et al. (2012) is the only identifiable exception (Aronoff et al. 2013; Becker 1978; Brandon & Lewis 1999; Marans & Edelstein 2010; Midden et al. 1983; Stern & Gardner 1981).

Financial incentives and rewards also influence motivation (Kehbila et al. 2009; McMakin et al. 2002; Wiser et al. 2001; Wright et al. 2008). It is unclear whether this type of motivation changes norms over the long run once the incentive disappears (Bradford & Fraser 2008; Kannan & Boie 2003; Neurman 1986; Wright et al. 2008). Arnoff et al. (2013) suggests that indirect rewards encourage long-term behavioral changes and can be achieved by combining incentives with commitments.

CAMPAIGN MESSAGING

In theory, information strategies rest upon the idea that providing more, higher quality information about environmental impacts of various activities encourages consumers to conserve (Delmas, Fischlein, Asensio 2013). In research, however, results of providing such information vary, from claims that more information has little to no effect on energy consumption (Abrahamse et al. 2005) to estimates that educational programs result in as much as 30% reduction in use (Laitner et al. 2009; Gardner & Stern 2008). Delmas et al. (2013) provide a comprehensive analysis of energy conservation residential studies from 1975 to 2012, and determine that individualized feedback via audits and consulting results in the largest reductions.

Research in the residential sector finds that despite most environmental messaging focusing on self-transcendent values, only a small part of the population feels motivated by this reference frame. Thus, improper use of campaign messaging can backfire (Nan 2008; Quick & Stephenson 2007). Social norms and financial responsibilities may play vital roles in motivating behavioral change, but it is important to remember that the same appeals may not motivate all subgroups (Dietz et al. 2010; Arpan, Opel, & Lu 2013).

Arpan, Opel, and Lu (2013) identify consistent and strong influences of value relate to perceived associated risks of residential energy use (represented by political orientation). However, no correlation exists between worldview and the quantity of energy reduction actions; both political orientation groups (conservative and liberal) act with different motivations (Arpan, Opel, & Lu 2013). The study concludes that framing energy conservation broadly as a moral behavior may allow the appropriate degree of flexibility, so that both groups act upon their perceived important values and goals (Arpan, Opel, & Lu 2013).

In general, people pay more attention, time, and thought to negatively framed information (Cialdini et al. 2006). In a study on petrified wood theft, injunctive normative messaging information that “theft is strongly disapproved” proved the most successful in deterring theft (Cialdini et al. 2006). As discussed earlier however, combining descriptive and injunctive norms helps prevent promoting an undesired behavior (Schultz et al. 2007). For example, “You are using more energy than others,” (descriptive norm), “but people in your community expect you to conserve energy,” (injunctive norm). The projection effect is also an important component of effective campaign messaging. However, the act of engaging in a particular behavior triggering an assumption that everyone else does as well can act as a limiting factor in analyses (Arpan, Opal, & Lu 2013).

Successful sustainable behavior pilot programs, such as those at Tufts University and Pacific Oregon University brand campaigns using a slogan and logo (Marcell et al. 2004; Cole & Fieselman 2013). Many energy conservation pilot programs also follow a method called Community Based Social Marketing (CBSM). This process seeks to identify and address barriers that prevent a specific population from turning environmentally driven attitudes and concerns into desirable actions (Aronoff et al. 2013; McKenzie-Mohr 2011). Until recently, campus-based energy conservation programs often focused on logistical and technological energy efficiencies of buildings. While this represents an important factor to decrease energy footprints, technological advancements are limited. The effectiveness of technology is dependent, to some degree, upon human behavior; humans can significantly strengthen or weaken the effectiveness of technology through adoption and maintenance (Kaplowitz et al. 2012; Lutzenhiser 1993; Parece et al. 2012).

CBSM generally involves the following five steps: 1) selecting a desired behavior to promote; 2) identifying potential barriers and benefits to the specific behavior; 3) developing strategies to overcome the identified barriers; 4) piloting the strategy; and 5) evaluating the program (McKenzie-Mohr 2011). In essence, this theory identifies social norms within the target population and seeks to implement a new social norm.

Common strategies used in energy conservation behavioral studies include: the use of education, commitment, prompts, visual feedback, incentives and rewards, and stigmatization for negative behaviors. According to Dwyer et al. (1993), the most effective form of commitment is active, written, public, and made on a group level. Clear and concise prompts can help reduce forgetfulness, and when positively framed may be more effective (McKenzie-Mohr 2011; Searle 2010).

Incentives can also be useful, though are cautioned, as behaviors may become linked to the incentive. It is not clear if studies using financial incentives transformed a social norm, or if effects were temporary due to the monetary values attached to participation (Marcell et al. 2004; Cole & Fiselman 2013; Odom et al. 2008; Peterson et al. 2007).

Previous Studies in Higher Education

Many previous studies on sustainable behavior in universities use CBSM to identify barriers through surveys and in-depth interviews among the targeted population. Cole & Fieselman (2013) describe a program implemented at Pacific University Oregon that successfully changed nearly two-thirds of the faculty and staff's environmentally-related office behaviors using CBSM campaign strategies, such as prompts, commitment, incentives, convenience, norms, and social diffusion. A pilot program at Tufts University targeted electricity consumption in two upper-class-suite-style dormitories. Through an eight week social marketing campaign, the experimental dorm reaped a greater change in students turning off computers (Marcell et al. 2004).

Kansas State University also utilized a CBSM study focused on increasing sustainability in laboratories through use of a visual feedback system (Aronoff et al.

2013). The biggest barriers included: lack of motivation, forgetfulness, lack of social pressure, and lack of knowledge (Aronoff et al. 2013). The ‘Rewire’ campaign at Toronto University attempted to create an atmosphere in which resident hall students felt negatively judged if they failed to exhibit energy conservation behaviors. Pre and post intervention questionnaires revealed positive increases in conservation behaviors related to turning off lights, computers, and TVs (Chan et al. 2012).

Studies outside CBSM framework also use qualitative data from interviews or surveys to understand barriers preventing sustainable behavior preceding outreach program development. Parece et al. (2012) focused on student-controlled devices and appliances in residential halls and Greek houses at Virginia Tech. Four intervention groups received a different outreach method over two semesters (basic information, simple feedback, comparative feedback, and coaching. Due to possible methodological weaknesses, regardless of strategy, electricity usage decreased in each hall (Parece et al. 2012).

Kaplowitz et al. (2012) interviewed science laboratory personnel (principal investigators, lab staff, and students) at Michigan State University to understand attitudes and knowledge of principal; no difference between the personnel strata was detected. The interviews revealed the action-value gap, energy conservation as a lower priority in the lab, and four primary barriers: lack of knowledge, economic (limited available resources and not bearing costs directly), operational constraints (good science over conservation), and limited access to efficient equipment (Kaplowitz et al. 2012).

Fahim and Wang (2012) looked at the energy efficiency and performance of buildings at University of Illinois, primarily focused on operations and maintenance, but also involving interviews with building staff and users.

Despite whether pilot programs use CBSM, identifying barriers and understanding the general level of knowledge and perceived attitudes among the target population is vital to any program.

THE NEW ECOLOGICAL PARADIGM

The New Ecological Paradigm (NEP), created by Dunlap and Van Liere in the mid-1970's, forms the basis of environmental sociology. The NEP conceptualizes ecological consciousness, popularly used as a measure of environmental concern (Dunlap et al. 2000). The original paradigm utilized a set of 12 Likert statements to measure the following ideas: humanity's ability to upset the nature of balance, growth constraints on human population, and humanity's right to rule over nature (Dunlap & Van Liere 1978). This worldview measurement is not a clear-cut indicator of attitudes or beliefs, but rather it taps into "primitive beliefs" – beliefs from one's inner core that represent basic truths about physical and social realities and the nature of the self – about humanity's relationship with the nature of the earth (Dunlap et al. 2000). Many believe this worldview influences attitudes and behaviors towards environmental issues (Dalton et al. 1999).

The revised NEP includes 15 statements that also address global environmental change and "human exemptionalism" – the idea that humans, unlike any other species, are exempt from the constraints of nature (Dunlap & Catton 1994). This scale is more internally consistent than the original version and includes seven even–numbered anti-NEP statements –disagreement indicates a pro-ecological view (Dunlap et al. 2000).

A higher score on the NEP scale represents a 'pro-ecological' worldview, and should lead to pro-environmental beliefs and attitudes (Dunlap et al. 2000). Previous research identifies that younger, well-educated, and politically liberal adults more commonly associate with pro-environmental worldviews (Dunlap et al. 2000).

GAPS IN THE LITERATURE

According to *Texas State University's Fiscal Year 2015 Operating Budget*, the University spent $8,194,637 on utilities for housing payments during fiscal year 2014, which includes electricity, water, steam, and chilled water. The University budgeted nearly $1 million extra for utility operating costs, representing approximately 2% of the University's total budget. This, of course, does not account for any externalities resulting from greenhouse gas emissions or other negative environmental consequences.

Previous studies on sustainable behavior in universities use CBSM to identify barriers through surveys and in-depth interview (Marcell et al. 2004; Cole & Fiselman 2013; Aronoff et al. 2013). Studies outside the CBSM framework also rely on similar methods prior to the development of outreach programs (Marans & Edelstein 2010; Fahim & Wang 2012; Kaplowitz et al. 2012). This research follows the CBSM process as closely as possible, in developing and designing outreach materials.

I discovered a lack of literature focusing on thermostat behaviors in residence halls. This thesis research seeks to help address that gap by looking at thermostat-related attitudes and behaviors amongst students living in on-campus university housing, and analyzing reported and actual behaviors between two residence halls, each with individually controllable thermostats in every room. One hall (Residence Hall A or Hall A) contains restricted thermostats with viewable thermostat set point and actual room temperature data to analyze actual (observed) behaviors.

In fall 2012, Texas State University installed energy monitors on over 30 buildings across the campus to track different types of energy use (i.e. electric, steam, chilled water). When working correctly, the energy monitors attached to the buildings record energy demand, usage, and outside temperature and relative humidity data in five-minute increments. Preliminary research analyzed the relationship of aggregated yearly electric power usage kilowatts (kW) with building specifications, such as year built, number of floors, gross square footage, and building type for 18 buildings.

This research also looked at kilowatt differences between variables such as residence hall, day of the week, type of day, day of the year, and time of the day, using data compiled from multiple secondary sources, including Utilivisor, Texas Higher Education Coordinating Board (THECB), and Texas State University. No variable in this study directly measured the effect of restricted thermostats on a building's total energy usage. Analyses revealed no statistically significant variation between building types and overall energy usage, perhaps due in part to a large variation of gross square footage within the groups. Using the two residence halls in the dataset with the most similar building specifications, a significant variation in kW usage existed not only between these two, but also between times of day. This data suggests that behavior (such as thermostat adjustment, appliance usage, and leaving lights on in an unoccupied room) may help explain the remaining variation of kW usage in residence halls.

Unfortunately, one of those halls did not have controllable thermostats in each resident's room. Residence Hall B (or Hall B) is the only other residence hall in the dataset that meets this requirement, though building specifications vary greatly between Hall A and Hall B. Hall A has a maximum occupancy of 92 students, a much smaller gross square footage, and opened in 1946 (THECB 2012). Nearly 60 years later, in 2004, Hall B opened, with maximum occupancy of 469 students and a gross square footage nearly six times larger than Hall A. Both buildings have four floors; however the rooms in Hall A are primarily double occupancy rooms with community bathrooms. Hall B has single occupancy rooms with shared bathrooms within the suite, in addition to a separate living area (Texas State DHRL 2015). Thus, students living in Hall B can have up to three suitemates, while students in Hall A either live alone or with one other.

CHAPTER III.

METHODOLOGY

Hall A and Hall B are the two residence halls of interest for this thesis research. The unique attribute as the only residence hall on the Texas State campus with a restricted thermostat and remotely visible data on the device's set point and actual room temperature makes Hall A an interesting case. Hall B is included simply because it is the only other residence hall on-campus with energy monitoring data and individually controllable thermostats.

Building specifications vastly differ between these two residence halls, as do the room types. Another noteworthy difference includes a limitation on the thermostats in Hall A, between a range of 68°F to 70°F for cooling and 72°F to 75°F for heating. The set-point control, however, is not restricted, and ranges from 50°F to 90°F, giving a false sense of perceived control. Hall B residents are not limited to certain temperature ranges. See Figure 1 for images of the thermostat types found in each hall.

The three data sources for this research include:

- Utilivisor energy monitoring data: this data summarizes energy usage by building;
- Hall A thermostat data: this data provides thermostat set point and actual room temperature data points for each of the 46 individual living quarter rooms, downloaded at five daily time intervals over the course of two months to track behavior;

- Quantitative student resident survey data: survey data gathered at two different time periods to understand attitudes, behaviors, and habits relating to thermostat usage and energy consumption.

Figure 1. Thermostats. On the left is the Seimen's model thermostat found in each room at Hall A. On the right is the White-Rodgers model thermostat used Hall B rooms.

STUDY PERIODS

The study period is divided into five time periods from March to May in 2015: Spring Break, Pre-Intervention, Intervention, Post-Intervention, and End of the Year. Noteworthy, the timeline shifted a few weeks later due to a late submission to the Institutional Review Board, with the pre-intervention period scheduled to begin February 26th and the last day of the post-intervention period to end April 19th.

Thermostat data from Hall A was collected at five time intervals (3:00 AM, 9:30 AM, 12:00 PM, 5:00 PM, and 10:30 PM) every day during each of the five time periods. Earlier research established the five daily time intervals. The original data includes 62 rooms plus the laundry room. The researcher removed room numbers not listed on Hall A's floor plan from the dataset (Texas State DHRL 2015). The modified dataset includes each thermostat's set point and actual room temperature for all 46 resident-occupied rooms in Hall A.

Time Period 1: Spring Break

The time period, Spring Break (SB), began Friday, March 13, 2015. Though still technically a regular class day, according to the University's *Fall 2013 Instructional Space Usage Efficiency* report, Friday classes are uncommon and thus students may start vacations early. The period concludes ten days later on Sunday, March 22, 2015. Due to circumstances beyond control, including Spring Break as time period was unavoidable. It should be noted that during this time, residence halls consume considerably less energy than during times when classes are in session because many students leave campus.

Time Period 2: Pre-Intervention

The Pre-Intervention (Pre-IV) period provides a baseline period for normal student and building operations, prior to the distribution of any outreach materials. The period began Monday, March 23, 2015 and lasted 14 days until Sunday, April 5, 2015. The actions carried out during this period are described below.

In an attempt to coincide with the authority heuristic (Cialdini 2001) – which states survey completion probability increases if requested by a person of authority – residence hall directors, with approval from the Associate Director of DHRL, handled almost all correspondence to students. Residence hall directors were also utilized as a part of this study, to measure the influence of their authority. On March 23rd, residence hall directors distributed the pre-intervention survey via email to occupants in both halls, a potential sample size of 523 students. The survey sought to measure reported thermostat and energy-related attitudes and behaviors. On March 26th, students received an email reminder to complete the survey. The delivery of the survey and reminder possibly prompted some students to give more thought to energy-related actions and behaviors, though this effect is not measurable. A chance to enter a raffle at the end of the survey helped incentivize participation. A small grant from the Texas State Environmental Service Committee (ESC) helped provide funding for these prizes, which originally included iTunes and Amazon gift cards and an Amazon Fire TV. However, because of purchasing requirements, two Amazon Fire TVs acted as incentives for the pre-survey (the post-survey duplicated this concept, too).

At the close of the pre-survey, I coded and analyzed answers to follow CBSM protocols– commonly used in pilot outreach programs – as closely as possible. Responses helped understand how to message and format outreach materials for campaign to help reduce perceived barriers.

Time Period 3: Intervention

The Intervention (IV) period lasted 12 days, beginning Monday, April 6, 2015 and ending Sunday, April 17, 2015. Though originally scheduled to last ten days, inadequate assistance from residence hall directors delayed email and signage distribution prompted a two day extension.

Outreach included posting educational fliers and posters[1] in common areas, hallways, community bathrooms, and on doors. Funds from the ESC also covered printing costs. Hall A's residence director failed to hang all the requested signs, so students received an email on April 10th with injunctive and descriptive norm textual messaging along with an image of the 11" x 17" poster (see Appendix F). DHRL rules restrict who can post signs in the residence halls, so the hall directors and their advisors helped hang materials.

The design for the outreach campaign loosely followed the community behavior social marketing (CBSM) process. The first step involved designating energy conservation as the desired behavior, followed by identification of barriers based on relevant literature. The pre-survey served little help in identifying barriers relevant to Texas State students living on-campus because of a relatively low response rate. The campaign focused on addressing a previously identified barrier, knowledge and awareness. Unfortunately, due to limited resources, implementing visual feedback was not feasible during this campaign. Therefore, the campaign consisted of passive educational outreach, with four different poster designs hung throughout the two residence halls (the pilot is the fourth step of CBSM).

The DHRL Marketing Coordinator aided in the creation of the logo and two promotional materials. Following models from previous pilots, the campaign received a logo and brand: "Bobcats Save Energy," a depiction of the trademarked Texas State Bobcat (with approval granted by the licensing department), a stack of dollar bills, and a lightning bolt (Figure 2). Each piece of promotional material contained the logo.

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[1]Reference the Appendix for outreach materials.

Figure 2. Bobcats Save Energy. Logo/branding created for outreach campaign.

The ‘unplug’ sign communicates financial and environmental consequences. It demonstrates the impact if every student living on-campus left laptop chargers plugged into the outlet for an entire year. Calculations accounted for the maximum on-campus housing carrying capacity [rounded down to] 3,400 students. A rate of .075 cents per kWh (Texas Star 2014) was applied to the average of the five notebook computer settings from Lawrence Berkley National Laboratory’s Standby Power Data (fully on and charged, fully on and charging, off, power supply only, and sleep) (20.57 watts). The U.S. Environmental Protection Agency’s (EPA) greenhouse gas calculator provided the amount of carbon dioxide emissions resulting from this proposed scenario. A flier designed by Harvard University’s Office of Sustainability (2009) inspired this sign.

A second sign questions the students’ ability to conserve energy. Designed and created by the researcher, it focuses on energy habits related to thermostat usage. A visual pie chart shows the approximate percentage of electric consumption rate by end-use for the average Texas household. The text puts the data into easily relatable and visual terms.

The fan flier, designed and created by the researcher, simply illustrates a common misperception that leaving ceiling fans on helps maintain a lower room temperature. The Marketing Coordinator could not create this flier, thus, the researcher's limited knowledge of Adobe Photoshop prevented printing the flier on bright colored paper to enhance design.

A light switch flier, designed and created by the researcher, indicates how easy it is to flip the light switch prior to exiting a room using descriptive and injunctive norms. Similar to the issue above, this flier was meant to be printed on black paper, to provide stark contrast.

A fifth sign, an 11" x 17" poster acted as a tip sheet and included various energy conservation behaviors. Inspiration came from an energy factsheet designed by Yale University's Office of Sustainability. The researcher's sketch given to the Marketing Coordinator used graphics rather than standard bullet points (plugs next to device/appliance tips, thermometers next to thermostat related tips, and light bulbs for lighting related tips). Unfortunately, these design elements were not reflected in the final version of the poster.

Time Period 4: Post-Intervention

The Post-Intervention (Post-IV) period started Saturday, April 18, 2015, falling right before the last regular week of the semester when students typically have final tests, presentations, and projects due. Thus, overwhelmed students may have neglected emails from the residence hall directors. Survey reminders were not delivered on the scheduled dates, again due unreliable assistance from residence hall directors.

On April 20th, students received a post-intervention survey via email – nearly identical to the pre-intervention survey, with the exception of a few additional questions related to the outreach program. One follow-up reminder email went out. Each residence hall received the survey reminder on a different day (April 24th for Hall A and April 28th for Hall B) because Hall B's director would not send the reminder through their email address. Instead, an alternate sender delivered the email reminder. In light of this challenge, the survey remained open thru the end of the post-intervention period. To incentivize participation, again, respondents could enter their email address to enter another raffle, for a chance to win one of two Amazon Fire TV Sticks. The period concluded on Friday, May 1, 2015.

Time Period 5: End of Year

A final time period, End of Year (EOY), lasted 12 days, from Saturday May 2, 2015 until Wednesday, May 13, 2015. This period includes the last day of regularly scheduled classes, May 4th, in addition to final exam days (May 6th thru May 13th), which rather than regularly scheduled classes, each course meets at an assigned time to take a final exam. Energy consumption levels may have been most affected during this time, with students spending more time in their rooms and warmer temperatures.

SURVEYS

As previously discussed, a pre- and a post-survey provide data on habits, behaviors, and attitudes of the target population. Many of the survey questions derive from a survey designed by Collins (2010) in a study on behavior, comfort, and energy consumption in student residence halls. The pre-survey's intentions included giving directional approach for the passive outreach campaign and collecting a baseline measurement. Nearly identical, the post-survey incorporated specific questions regarding the campaign to measure effectiveness and awareness. Both surveys collected limited demographic information, background on habits and behaviors at the individual's previous place of residence, and questions relating to both thermostat usage and broader energy consumption. The survey ended with a few proposed situations imposing a financial cost associated with energy consumption, a Likert scale using the New Ecological Paradigm to measure environmental consciousness, and two opinion leaderships scales – one for energy conservation and one for sustainable behavior. The survey can be found in Appendix H.

VARIABLES

Independent Variables

The following identification variables come from close-ended survey questions: age, gender, year in school, number of suitemates or roommates, number of bedrooms in childhood home, and residence hall. Room number was also collected, however, by means of a free-response textbox.

Two questions gathered habitual and behavioral data related to the individual's previous place of residence: the degree of temperature control possessed and the frequency participant viewed the electric bill.

Since thermostat control and behavior are the study's primary focus, several questions related to this topic: how often one feels air conditioning or heat does not work; ideal room temperature; whether students adjusted the thermostat before leaving for Spring Break*;* and how often an individual adjusts air conditioning or heating when room temperature is uncomfortable.

Broader energy usage behaviors and habits are also studied, including: how often one thinks about the amount of energy consumed in their room and the degree of familiarity with energy consumption of various devices and appliances.

Total energy consumption for each residence hall is measured in total kilowatts per hour (kWh)[2]. Energy consumption per student is estimated by dividing total kWh by the total number of residents. The average daily outside temperature (°F) and average daily relative humidity (%) are used to control for weather changes when analyzing Hall A's thermostat set point and room temperature data.

Unlike some other residence halls, Hall A relies only on electric energy (kWh). Aggregation of the data enables analysis of the relationships and variations between average daily kWh in Hall A during each of the five time periods. To acquire the daily kWh, the total kWh at the beginning of each day (12:00 am) is subtracted from its ending total (11:55 pm). In some cases, data did not exist up through 11:55 pm. To alleviate this issue, an average of kWh (on days with complete data) used at 11:55 PM is subtracted from the following day's starting kWh used at 12:00 AM (an average of 5 kWh during this five minute increment). Five days within the two-month period lacked substantial data points (April 14th, 15th, 18th, 21st and May 10th thru 13th). In order to prevent these days from completely skewing the dataset, average kW were sorted in ascending order

[2]Kilowatts are a measure of power, or the rate at which energy is generated or used. Kilowatts show how fast a building is consuming energy; a lower kW suggests slower energy use, while a higher kW suggests quicker energy use. One kilowatt is equivalent to 1,000 watts. Kilowatts can be aggregated and compared regardless of the extent of time between two periods of comparison differs. Kilowatts per hour (kWh), a unit of energy, on the other hand, are not as tangible or easily comparable. A kilowatt per hour equals power plus time, or the rate at which energy is used over a certain period time. For example, kWh will continually increase over the course of a day or month. Thus, in order to compare kWh across different months, the unit must be normalized to account for the variation in the number of days in a month (Energy Lens 2014).

and total kWh per day were estimated using the surrounding data points. This was not feasible on April 19th and 20th or May 10th and 13th.

Dependent Variables

The revised New Ecological Paradigm (NEP) scale measures environmental consciousness. All 15 statements are included in the index. Each of the odd numbered statements asks positive environmental statements (i.e. “When humans interfere with nature it often produces disastrous consequences”), and each of the even numbered statements asks negative environmental statements (ex: “Humans have the right to modify the natural environment to suit their needs). To correctly index this scale, the seven negative statements were reverse scale coded (strongly disagree was assigned a value of one, and strongly agree assigned a value of five). Each participant’s 15 responses added together compose the index, with a possible value ranging from 15 (most environmentally conscious) to 75 (least environmentally conscious).

Opinion leaders give advice and opinion seekers ask for it (Flynn, Goldsmith, and Eastman 1996). Using the opinion leader scale created by Flynn, Goldsmith, and Eastman (1996), the survey includes two related indices, one on opinion leaders of energy conservation and one on opinion leaders of sustainable behaviors. Each scale contains five statements[3]: 1) My opinion on [energy conservation/sustainable behavior] seems not to count with other people; 2) When they want to understand [energy conservation/sustainable behavior], other people do not turn to me for advice; 3) People that I know engage in [energy conservation/sustainable behaviors] based on what I have told them; 4) I often persuade others to engage in [energy conservation/sustainable

[3]The opinion leadership scale includes six statements, however one was inadvertently omitted.

behaviors]; 5) I often influence people's opinions about [energy conservation/sustainable behaviors]. Using a Likert scale, students selected to what degree they associated with each statement on a scale from one (strongly agree) to five (strongly disagree). For both indices, statements one and two received reverse coding. To create the index, each participant's five responses were added together. Possible value scores ranged from five (strong opinion leader) to fifteen (weakest opinion leader or non- opinion leader). The residence hall directors were also used to analyze the effect of opinion leaders.

Set-point temperature (°F) and actual room temperature (°F) within individual residential rooms in Hall A, collected at five daily time intervals over the course of two months also act as dependent variables.

Now that the variables for the study are identified, I will tie this back into the previously discussed literature review. The following questions are under review in this study:

- Research Question #1: What behaviors do students living in in on-campus residence halls, with thermostat control capabilities, display with regard to energy usage, and specifically with regard to thermostat-related behaviors?
- Research Question #2: Is there is a difference between reported temperature settings and actual temperature settings? What effects might this have on building energy consumption?
- Research Question #3: Do students' reported views and attitudes align with their reported behaviors?

Table 1. Summary of Statistics for Variables of Interest

Variable	N	Min.	Max.	Mean	Std. Dev.
Age	87	2	7	3.34	.974
Gender	87	1	2	1.83	.380
Number of living mates	87	0	4	3.13	1.421
How many bedrooms did the home you spent most of your childhood in have?	87	3	6	4.37	.733
Residence hall	84	1	2	1.88	.326
How often did you view electric bill at your previous place of residence?	87	1	5	1.80	1.150
Degree of temperature control over in living space before college	87	1	5	3.33	1.138
How often heating or air conditioning DOES NOT work	83	1	5	1.96	1.109
Ideal room temperature setting	83	1	8	2.49	1.329
Frequency adjust the thermostat in your room, on daily basis	84	1	3	1.81	.719
If room temperature is too hot/cold, how often adjust heater or AC	70	1	5	3.69	1.291
Frequency think about amount of energy consuming in your room	65	1	5	2.63	1.098
Adjust or turn off thermostat before Spring Break?	67	1	3	2.12	.879
Degree of familiarity with energy consumption of different electronic devices/appliances	73	1	5	2.40	1.139
Sustainable Behavior Opinion Leader Index	72	9	24	15.71	3.53
Energy Conservation Opinion Leader Index	72	8	24	16.18	3.301
NEP Index	67	21	57	37.30	7.59
Avg. Pre-Intervention Mean Set Point Temperature	10	54.18	81	68.15	8.71
Avg. Pre-Intervention Mean Actual Temperature	10	69.96	80.85	72.01	3.26
Avg. Post-Intervention Mean Set Point Temperature	10	57.05	94.25	71.77	11.29
Avg. Post-Intervention Mean Actual Temperature	10	69.91	80.85	71.93	3.217

CHAPTER IV.

RESULTS

Between both surveys, a total of 90 surveys were submitted, however eight of those surveys were completed by the same individual at both the Pre-Intervention (Time 1) period and Post-Intervention (Time 2) period. One of these eight individuals, for whatever reason, submitted two post-surveys.[4] Therefore, 81 unique individuals participated in this research project, and 89 unique responses were submitted. The total potential sample population totaled 523 students.

The overall response rate of 17.21% is determined by number of survey responses submitted at either time, regardless of completion, divided by the total potential sample population. Of the 90 responses, 10 came from Hall A, 75 from Hall B, and 5 failed to associate with a residence hall. Only 74 responses were fully completed, an 82% completion rate (Table 2). Time 1 received 56 responses – a response rate of 12.62% – and Time 2 received 29 responses–nearly halving the response rate to 6.5%. Completion rate for Time 1 equaled 80.36% and 85.29% for Time 2 (Table 2).

During the spring 2015 semester, Hall A was 91.3% occupied; while Hall B was 94% full (maximum occupancy rates of 92 and 469 students, respectively). Ten responses came from Hall A residents (13.2% of the total responses), and Hall B residents completed 66 responses (86.8% of the total responses). Based on these occupancy rates, response rate percentages were similar between the two halls. Hall A's response rate –

[4]This individual that completed a pre-survey and two post-surveys (the first completed on April 21and the second completed on April 28) recorded two different responses on the pre and post surveys for number of bedrooms in childhood home and age, both identifying and static classifier (response choice 6 and 5 for bedrooms, and 4 and 5 for age, respectively). Choice 5 for both bedrooms and age was selected on both post-surveys, so in combining the information for the pre vs. post dataset, this was the choice selected used. In deciding between the post-surveys researcher, deleted the first response because it was not completed as entirely as the second. These issues raise concern for the validity across all responses received, discussed later.

calculated by dividing occupancy of 84 students by 10 survey responses – equates to 11.90%; and Hall B's response rate –calculated by dividing an occupancy rate of 523 by 66 survey responses— equals 12.62% (Table 2).

Table 2. Response and Completion Rates by Residence Hall and Time Period

	Responses from Hall A	**Responses from Hall B**	**No Residence Hall Reported**	**Total Responses**
Responded (Time 1 + Time 2)	10	75	5	90
Response Rate	*11.90%*	*17.08%*		*17.21%*
Completed Surveys (Time 1 + Time 2)	7	67		74
Completion Rate	*70%*	*89.33%*		*82.22%*
Responded (Time 1)	5	47	4	56
Response Rate	*5.95%*	*10.71%*		*10.71%*
Completed Survey (Time 1)	2	43		45
Completion Rate	*40%*	*91.49%*		*80.36%*
Responded (Time 2)	5	26	3	34
Response Rate	*5.95%*	*5.92%*		*6.50%*
Completed Survey (Time 2)	5	24		29
Completion Rate	*100%*	*92.31%*		*85.29%*

Of the 81 individual participants, the sample population consisted of 19% males and 81% females (15 and 64 individuals, respectively). Two individuals failed to report a gender. According to data from the *April 2015 DHRL Occupancy Report*, across residence halls in study, 34.61% of students identified as male and 65.40% identified as females. For Hall A, the gender composition splits 44.05% male and 55.95% female, while for Hall B it splits 32.80% male and 67.20% female (Table 3). Survey responses by gender by residence hall are available in Table 4. Thus, the sample population that participated does not quite represent the actual population.

Across both surveys, nearly half of respondents (46.8%) were 19 years old, followed by 20 year olds (25.3%), and 18 year olds (16.5%). These individuals were primarily first and second year students at the time of the survey (44.3% and 39.2%, respectively). Only two individuals reported as fourth year students. Across both surveys, approximately two-thirds of individuals lived with three suitemates, 12.7% had only one roommate, and 10% lived alone.

Table 3. Residence Hall Occupancy Rates by Gender

	Male	Female	Total
Hall A	37 *44.05%*	47 *55.95%*	84
Hall B	144 *32.80%*	295 *67.20%*	439
Total	181 *34.61%*	342 *65.39%*	523

Table 4. Survey Responses by Gender by Residence Hall

	Male	Female	Total
Hall A	2 *20%*	8 *80%*	10
Hall B	12 *18.18%*	54 *81.82%*	66
No Hall	1	2	3
Total	15	64	79

RESEARCH QUESTION #1:

Thermostat & General Energy Consumption Behaviors/Habits

The first research question seeks to identify what behaviors students living in on-campus residence halls, with thermostat control capabilities, display with regard to energy usage, and specifically with regard to thermostat-related behaviors.

Thermostat Usage

Just over half the survey respondents report that they often or always agree with their roommate(s) on the thermostat setting; one-fifth sometimes agree, and two-fifths rarely or never agree. Nearly half of participants reported the thermal conditions in the common areas on par with conditions in their room. When asked how thermal conditions in the common areas compared to those within their room, 20% were unsure, 11% said somewhat worse, and 22% reported some degree better. Across both halls, approximately 33% reported adjusting their thermostat, and 45% said it remained untouched because one or more persons did not travel anywhere during this break.

To see how often students engage in behaviors other than adjusting their thermostat when the room temperature becomes too hot or too cold, I created an index, with a scale from 12 (never taking any other actions) to 60 (always taking other actions). These actions include: opening or closing the door or window, changing clothing, turning the computer on or off, turning lights on or off, turning electric equipment on or off, eating or drinking something warm or cold, turning a fan on or off, moving to another area of the room, leaving the room to go to a common area, leaving the residence hall building, and adjusting activity level. The index allows a comparison between the sum of these actions and a statement on how often the thermostat is adjusted in this same situation. According to the index, 45% rarely engaged in these other actions and 42% sometimes engaged. Whereas 87% of respondents rarely or sometimes take actions besides adjusting their thermostat to change comfort levels, 60% often or always touch their heater or air conditioning. A one-sample t-test comparing these two types of actions (actions excluding adjusting the thermostat), shows a statistically significant difference between the two (Table 5).

Table 5. One Sample T-Test for Question #16. Is there a difference between how often the AC/heater is adjusted if room temperature is uncomfortable and an index of all actions excluding direct adjustment of the temperature

	t	df	Mean Difference	95% Confidence Interval of the Difference	
				Lower	Upper
Uncomfortable Temperature Index (Sum of 12 actions excluding adjusting AC/Heater), Categorized	26.222*	66	2.687	2.48	2.89
How often do you adjust the AC/heater if room temperature uncomfortable	23.877*	69	3.686	3.38	3.99

*p-value < .000

Across all surveys responses, approximately 81% of students identified an ideal room temperature ranging between 68°F to 73°F. The mean ideal temperature does not significantly vary between time periods; a mean of 2.63 for Time 1 and 2.24 for Time 2 represents selections between 70-71°F and 72-73°F, respectively.

A free-response question, exclusively on the Time 2 survey, asked respondents to recall the most recent thermostat set point. These 28 free-response answers were coded into the same categories used for the close-ended ideal temperature question. Six answer choices ranged between 69°F and 79°F, each including a two-degree range (ex: 70-71°F); a seventh included any temperature above 80°F. Approximately 82% of students responded that the most recent thermostat set point ranged from between 68°F to 73°F; of these, 42.9% chose 70°F or 71°F. No significant variation exists between residence halls. Almost half of students (45.9%) also reported only adjusting their thermostat once a day and 36.5% reported never adjusting their thermostat on a daily basis.

Energy Usage

The majority of students always turn off overhead lights (85%), their TV (84%), and lamps (80%) before class, going out for the evening, and leaving for the weekend.

About half of the students (53.2%) never, however, unplug their phone chargers, unless they are leaving for the weekend. One-sixth of students rarely unplug their phone charger on these occasions. A little over half of the students often or always charge their laptops while they are away for class or away for the evening. According to responses, even when an individual leaves the residence hall for the weekend 67.6% never adjust the thermostat or heater controls.

Free-response question #32 asked respondents the average number of hours per day their phone, laptop, and/or tablet charge; averages on the post-survey exceeded averages from the pre-survey. An independent t-test analyzed differences between the pre- and post-surveys for this question. A significant difference exists between the lengths of time phones are charging – an average of 9.20 hours on the pre-survey and 12.68 hours on the post-survey. Students leave laptops, which consume more energy than phones, plugged into a charger an average of 13 hours each day. This question did not ask how long the charger was plugged into the outlet. Question #31 sought to understand how often students remove chargers from the outlet, but due to improper question formatting, this data is not useful.

Other Environmentally-Related Behaviors

Six statements pertaining to sustainable behaviors were indexed. These sustainable actions included how often a student: washes laundry, washes laundry in cold water, uses a drying rack, engages in recycling both in their room and on campus, and takes reusable bags to the store. The possible scale ranged from six (suggesting the participant never engages in these sustainable actions) to thirty (suggesting one always engages in these activities). Approximately 50% never or rarely engage, about 33%

engage sometimes, and approximately 17% often or always engage in these activities. This aligns with the sustainable behavior opinion leader index, in which 18% report themselves as strong opinion leaders for sustainable behaviors.

Interestingly, 48%.1 report never or rarely recycling in their rooms, even though recycling is offered in both residence halls. However, nearly 40% often or always engage in recycling on campus. Regarding other sustainable behaviors, 71% of students never or rarely use a drying rack after doing their laundry, and 58% never or rarely take reusable bags to the store.

RESEARCH QUESTION #2:

Reported vs. Actual Thermostat Habits & Settings

The second research question seeks to identify if a difference exists between reported temperature settings and actual temperature settings and possible effects on building energy consumption. An independent sample t-test between a student's ideal room temperature and the most recent thermostat set point (categorized) implies the existence of a significant relationship (Table 6).

Table 6. Independent T-Test for Thermostat Set Points. Is there a difference between ideal room temperature and the most recent thermostat set point?

					95% Confidence Interval of the Difference	
	N	**t**	**df**	**Mean Difference**	**Lower**	**Upper**
Ideal room temperature	84	17.335*	83	2.500	2.21	2.79
Recent temperature set point	29	11.170*	28	2.517	2.06	2.98

*p-value < .000

With regard to Hall A's energy consumption (kWh) as a building, significantly less energy is used on Saturdays during the two-month study period, compared to all other days of the week combined (Table 7). No other significant difference for any other day of the week when compared to the rest of the days of the week exists. During each of the five different time periods within the study, there is a significant difference between the average daily energy consumption (kWh) during Spring Break and the other four time periods; considerably less energy is consumed daily during this time period. Average daily energy consumption during the Intervention period also significantly varies from all other periods combined; more energy is consumed during this period. Average daily kWh during the End of Year period also varies significantly, however, with less energy consumed per day (Table 8).

Since there are only full survey responses from seven different rooms in Hall A, statistical analysis proves difficult. Reported behaviors and actual observations for each survey participant appear in Table 9.

A t-test of thermostat identified differences for some Hall A rooms between the average set points during Spring Break period and the Pre-Intervention period. A negative t indicates an increase in thermostat set point between the periods. A positive t indicates the thermostat set point decreased from Spring Break to Pre-Intervention. Five of the eighty-four rooms have a significantly positive t (Table 10).

Table 7. T-Test for kWh in Hall A by Day of Week

	kWh			kWh/student				
	Mean	**Std. Dev**	**SE Mean**	**Mean**	**Std. Dev**	**SE Mean**	**Sig (2-tail)**	**N**
Monday	949.275	153.757	38.439	11.3	1.83	0.458	0.458	16
All other days	920.113	144.295	14.429	10.953	1.718	0.172	0.458	100
Tuesday	939.137	120.735	28.458	11.18	1.437	0.339	0.636	16
All other days	921.379	149.743	15.126	10.969	1.783	0.18	0.636	100
Wednesday	955.424	133.428	33.357	11.374	1.588	0.397	0.356	16
All other days	919.129	147.107	14.71	10.942	1.751	0.175	0.356	100
Thursday	977.866	133.106	33.276	11.641	1.585	0.396	0.111	16
All other days	915.538	145.931	14.593	10.899	1.737	0.174	0.111	100
Friday	924.668	137.119	32.319	11.008	1.632	0.385	0.987	18
All other days	924.037	147.417	14.891	11	1.755	0.1772	0.987	98
Saturday*	852.274	156.559	36.901	10.146	1.864	0.439	0.022*	18
All other days*	937.333	139.99	14.141	11.159	1.667	0.168	0.022*	98
Sunday	870.657	163.4	43.67	10.365	1.945	0.52	0.143	14
All other days	931.475	141.946	14.055	11.089	1.69	0.167	0.143	102

*p-value < .05

Table 8. T-Test for kWh in Hall A by Study Period

	kWh			kWh/student						
	Mean	**Std. Dev**	**SE Mean**	**Mean**	**Std. Dev**	**SE Mean**	**N**	**t**	**Mean Diff**	**SE Diff**
SB	715.81	94.54	16.67	8.52	0.89	0.20	20	-12.32*	-251.72	20.43
All Other	967.54	115.77	11.81	11.52	1.38	0.14	96		-2.99	0.24
Pre -IV	892.04	104.67	19.78	10.62	1.25	0.24	28	-1.64	-42.31	25.78
All Other	934.35	155.13	16.54	11.12	1.85	0.20	88		-0.50	0.37
IV	990.54	84.88	17.33	11.79	1.01	0.21	24	-3.56*	83.72	23.55
All Other	906.81	152.94	0.21	10.80	1.82	0.19	92		0.99	0.28
Post-IV	970.77	120.15	24.53	11.56	1.43	0.29	24	1.78	58.80	32.99
All Other	911.97	149.35	15.57	10.86	1.78	0.19	92		0.70	0.39
EOY	1041.75	101.82	22.77	12.40	1.21	0.27	20	4.267*	142.12	33.31
All Other	899.63	141.29	14.42	10.71	1.68	0.17	96		1.69	0.40

*p < .001

Table 9. Observations vs. Reported Behaviors for Hall A Residents

	Room 1		Room 2	Room 3	Room 4	Room 5		Room 6	Room 7
	Person A	**Person B**	**Person A**	**Person A**	**Person A**	**Person A**	**Person B**	**Person A**	**Person A**
Ideal Temp	72-73	70-71	76-77	68-69	70-71	72-73	72-73	74-75	70
Mean Set Point (°F)	70.05		84.22	59.51	58.13	67.49		80.25	58.79
Mean Actual Room Temperature (°F)	69.98		71.71	70.75	72.5	70.58		80.88	70.57
Adjust Thermostat	1x/day	2-3x/day	2-3x/day	Never	Never	1x/day	2-3x/day	Never	Never
Recent Set Point (°F)	-	69	-	-	-	-	-	-	70
Adjust Thermostat before SB	-	No	Yes	-	No	Yes	No	No	Yes
Temp Roommate Agreement	Often	Sometimes	N/A	N/A	-	-	Often	N/A	N/A

Table 10. T-test between Spring Break and Pre-Intervention Set Point Averages

Room	t	Mean Diff	Std. Err	Room	t	Mean Diff	Std. Err
200	-4.430***	-2.1	0.47	**313**	-1.917	-0.442	0.231
201	-2.637*	-1.573	0.596	**401**	-2.364*	-2.490	1.054
202	-0.857	-0.180	0.211	**402**	-1.422	-0.098	0.069
203	-1.945	-0.074	0.038	**403**	-9.109***	-9.219	1.012
204	-4.588***	-2.078	0.453	**404**	-3.880**	-0.773	0.199
205	-7.655***	-5.508	0.719	**405**	-2.260*	-0.263	0.116
206	0.286	0.229	0.800	**406**	7.371***	1.106	0.150
208	1.389	1.007	0.725	**408**	-5.315***	-2.508	0.472
209	-4.716***	-1.136	0.241	**409**	2.346*	1.299	0.554
210	-3.480**	-0.296	0.085	**410**	-0.469	-0.021	0.044
211	-7.490***	-2.100	0.280	**411**	-11.508***	-2.827	0.246
212	-0.280	-0.118	0.419	**412**	-1.173	-0.055	0.047
214	-2.708*	-0.092	0.034	**414**	-2.807*	-0.685	0.244
215	-2.065	-0.100	0.048	**415**	-1.559	-0.063	0.040
216	-3.524**	-0.737	0.209	**417**	-1.715	-0.582	0.339
301	-0.066	-0.033	0.499	**418**	-2.442*	-0.093	0.038
302	-11.747***	-3.242	0.276	**419**	-3.746***	-0.651	0.174
303	-7.286***	-3.974	0.546	**421**	-1.119	-0.102	0.091
305	0.046	0.002	0.042	**422**	-2.188*	-0.071	0.032
306	3.366**	6.701	1.990	**423**	-2.807**	-0.116	0.041
309	-4.408***	-1.794	0.407	**424**	0.210	0.134	0.636
310	-3.006**	-1.388	0.462	**425**	8.844***	9.056	1.024
312	4.765***	1.459	0.306				

*p-value < .05
**p-value ≤ .01
***p-value ≤ .001

RESEARCH QUESTION #3:

Attitudes, Environmental Consciousness & Behaviors

The third research question investigates reported views and attitudes of students relative to environmental consciousness and corresponding behaviors. The action-value gap states behavior may not necessarily align with an individual's reported attitudes and views; meanwhile the planned behavior theory states that planned behavior is determined by attitudes, social norms, and perceived control. Thus, I hypothesized that reported views and attitudes would not match reported behaviors.

As previously mentioned, the anti-NEP statements received a recoding treatment, so that the 'strongly agree' response choice promoted agreement with environmentally conscious thought. An individual's NEP index ranged from 15 to 75, on a continuum of an individual's environmentally consciousness; 15 implies the most environmentally conscious worldview and 75 the least environmentally conscious worldview. Similar processes were applied to the energy conservation opinion leader and sustainable behavior opinion leader indices.

The opinion leader index scales range between 5 (strongest opinion leader) to 25 (weakest opinion leader or non-opinion leader). A large percentage of participants fell in the middle of the scale, unsure if they epitomized an opinion leader for either energy conservation or sustainable behaviors (37.5% and 44.4% respectively). Only 2.3% categorized themselves as strong energy conservation opinion leaders compared to 6% for sustainable behaviors. This is interesting in light of the wording on Question #53 (see Appendix), which states that sustainable behaviors include energy conservation.

To measure the impact of financial incentives, questions on both surveys asked students to report the degree of influence potential scenarios might have on energy conservation behaviors. Nearly half of students (46.7%) reported that receiving a check at the end of the semester with a reimbursement payment equivalent to the energy savings experienced in their room would influence their habits to a great deal (anything greater than response choice 'some'). While only 30.7% said they would be influenced a great deal if they had to pay a monthly electric bill, on top of boarding costs.

The survey also sought to gauge students' knowledge pertaining to the relationship between thermostat settings, negative environmental consequences, and electricity bills. Over 90% of respondents believe that thermostat settings impact the University's carbon footprint to some extent or greater. Nearly 95% believe the settings impact the University's electricity bill to some extent or greater.

Due to small sample sizes, testing associations between original thermostat and energy usage variables (i.e. *PrevTempControl*, *AdjustTherm*, *ViewElecBill*, *DeviceConsump*, *ThinkAboutConsump*, and *Reimbursement*) necessitated dichotomizing variables in order to run chi square and Fisher's exact tests. Response choices for these variables were identical, and thus dichotomized the same way: 'None/not at all' retained a value of one, with a new meaning of 'No (none/not at all).' Responses 'Not much, 'Some,' 'A fair amount,' and 'A lot' were combined, given a new value of two, and categorized as 'Yes (everything except none/not at all).' For variable, *ACBroken*, 'Never' kept a value of one; 'Rarely,' 'Sometimes,' 'Often,' and 'Always' were combined, assigned a value of two, and labeled, 'Yes (everything except never). *ThermSB* was the last variable dichotomized; 'Yes' was given a new value of two and

'No' a value of one, to keep consistent with the other variable coding. The third answer choice, '1 or more persons in my room did not leave' was reassigned a value of SYSMIS and not included in the analysis. Each of these variables acts as an independent variable, and is analyzed with the remaining variables as dependent variables (in addition to gender and residence hall).

Only a handful of statistically significant relationships exist among the dichotomized variables (Table 11). While the sample size, as previously mentioned, is small, several relationships with a p-value greater than 0.05, but less than 0.1, do not make logical sense, so 0.05 acts as the threshold. Fisher's exact test is utilized in instances when the expected cell count less than five exceeds 20%. Whether a student believes the thermostat settings impact the University's electric bill is related to whether the settings impact the carbon footprint as well. Whether a student adjusted the thermostat before Spring Break is related to whether they adjust the thermostat at least once a day and whether they viewed the electric bill at their previous residence. And whether a student is familiar with the energy consumption of various devices is related to whether the thermostat is adjusted at least once daily.

Table 11. Chi Square and Fisher's Exact Test Results

Independent Variable	Dependent Variable	Test	Value	N	Cells with expected count < 5
Whether thermostat Settings Impact University's Electric Bill	Whether thermostat Settings Impact University's Carbon Footprint	Fisher	*	73	3 cells (75%)
Whether adjusted thermostat before SB	Whether adjust thermostat at least once daily	Chi Square	4.361*	37	
Whether adjusted thermostat before SB	Whether viewed electric bill	Fisher	*		1 cell (25%)
Whether familiar with device consumption	Whether adjust thermostat at least once daily	Chi Square	4.142*	55	

*p-value < .05

Some of the variables described above are also used in two linear regression model sets, one with only thermostat-related behaviors as independent variables, and the other with broader energy behaviors as independent variables. Both models also use at least five identifying independent variables (age, gender, year in school, number of living mates, and number of semesters lived in a residence hall). The models measuring broader energy behavior variables also utilize number of bedrooms in home growing up as an independent variable. Each model was run three times, using a different dependent variable (sustainable behavior opinion leader index, energy conservation opinion leader index, or the NEP index). Only the statistically significant models are described.

The model measuring the impacts of thermostat-related behaviors uses the following independent variables: how often thermostat is adjusted on daily basis, how often AC/heater is adjusted if room temperature is uncomfortable, degree of temperature control in previous living situation, and whether the thermostat was adjusted before Spring Break (Table 12). Of the three dependent variables, the NEP Index best explains thermostat-related behaviors. Of the statistically significant variables, for every unit increase in the NEP Index, we can expect a -4.147 unit decrease in how often the thermostat is adjusted daily and a 3.057 unit increase in how often the AC/heater is adjusted if the room temperature is uncomfortable. Additionally, we can expect a 1.541 unit increase in the degree of temperature control in one’s living space before college. These independent variables only describe 7.2% of the sustainable behavior opinion leader index and 3.1% of the energy conservation opinion leader index.

Table 12. Linear Regression: Predicting environmental consciousness with thermostat-related behaviors

	Unstandardized Coefficient (B)	Std. Error
Constant	38.723**	6.451
Gender	-3.615	2.562
Semesters lived in residence hall	1.866	1.200
Age	.558	1.775
Year in school	-3.974	2.835
Number of living mates	-.392	.663
Frequency adjust thermostat daily	-4.147*	1.499
Frequency adjust heater/AC when room temperature is uncomfortable	3.057*	.988
Degree of previous temperature control	1.541	.900
Whether adjusted thermostat before Spring Break	-1.446	1.156

Adjusted R-Square = .146
*p-value ≤ .01,
**p-value <.001

The model measuring the impact of broader energy-related behaviors uses following independent variables: how often one thinks about energy consumption and the degree of familiarity with energy consumption of different devices and appliances. Table 13 shows the best-fit model — the independent variables that explain the greatest percentage of the dependent variable, approximately 25%. For every unit increase in the energy conservation opinion leader index, of the statistically significant independent variables, we can expect a -1.554 unit decrease in semesters lived on campus, a -1.599 unit decrease in age, a 4.084 unit increase in the year in school, a -.544 decrease in the number of living mates, a -1.127 unit decrease in the number of bedrooms in childhood home, a -.906 unit decrease in the amount of thought given to energy consumption, and a -.966 unit decrease in familiarity with energy consumption of various devices. All variables in this model are statistically significant, except gender.

When sustainable opinion leader index is the dependent variable, these same independent variables only describe 15% of the index, and the only statistically significant variables are: semesters lived in residence hall, year in school, and device consumption familiarity. These independent variables explain even less of the NEP index (only 3.5%), with thinking about consumption as the only significant variable ($p = 0.28$).

Table 13. Linear Regression: Predicting energy conservation opinion leaders with energy consumption behaviors

	Unstandardized Coefficient (B)	Std. Error
Constant	32.313***	3.953
Gender	-.801	.974
Semesters lived in residence hall	-1.554**	.578
Age	-1.599*	.729
Year in school	4.084*	1.343
Number of living mates	-.544*	.264
Number of bedrooms in childhood home	-1.127*	.512
Frequency think about energy consumption in room	-.906*	.360
Degree of familiarity with device energy consumption	-.966*	.375

Adjusted R-Square = .249
*p-value < .05
**p-value < .01
***p-value <.001

Similar to the linear regressions above, the binary logistic regressions use only thermostat-related independent variables or only energy-related independent variables. The independent variables listed in Table 14— age, gender, number of living mates, number of semesters lived in a residence hall, year in school, ideal room temperature, and degree of previous temperature control – predict 24% of the dependent variable, whether or not the thermostat is adjusted at least once a day.

Table 14. Bivariate Logistic Regression: Predicting whether or not students adjust their thermostat at least once a day

	B	Exp(B)	Std. Error
Age	.719	2.052	.476
Gender[5]	1.521*	4.576	.684
Number of living mates	-.099	.906	.197
Year in School	-.815	.442	.841
Number of semesters lived in residence hall	.680	1.974	.432
Ideal room temperature	-.081	.922	.197
Degree of previous temperature control	-.446*	.641	.257
Constant	-3.271	.038	1.843

Nagelkerke R-Square = .240
*p-value < 0.1

The best-fit binary regression model involves thermostat-related independent variables with the dichotomized *ThermSB* as the dependent variable (Table 15). Additional independent variables within this model include: ideal temperature, degree of temperature control in previous place of residence, frequency thermostat is adjusted on a daily basis, and the NEP index. These independent variables describe 78.7% of whether or not a student adjusted their thermostat prior to leaving for Spring Break. Only ideal temperature and the NEP index are statistically significant.

Table 15. Bivariate Logistic Regression: Predicting whether or not students turned off their thermostat before Spring Break

	B	Exp(B)	Std. Error
Age	-.114	.892	2.038
Gender	-3.991	.018	3.066
Number of living mates	.662	1.938	.920
Year in School	-3.178	.042	6.890
Number of semesters lived in residence hall	5.018	151.088	3.429
Ideal room temperature	1.956*	7.068	1.103
Degree of previous temperature control	.513	1.670	.667
How often adjust thermostat daily	.901	2.463	1.387
NEP Index	-.251*	.778	.150
Constant	-1.380	.252	6.228

Nagelkerke R-Square = .787
*p-value < 0.1

[5]Gender is coded as 1 for male and 2 for female.

CHAPTER V.

DISCUSSION & CONCLUSION

RESEARCH QUESTION #1:

Thermostat & General Energy Consumption Behaviors/Habits

This research question seeks to identify behaviors related to thermostats and energy consumption among on-campus student residents with thermostat control capabilities. Most students almost always turn off the TV, overhead lights, and lamps before leaving their room for an extended period of time (i.e. before class or going out for the evening). Interestingly, data suggests laptops are rarely unplugged before class or going out for the evening. In fact, more than half of students use these times away from their room as charging times. One of the fliers used in the outreach campaign addressed this information, calculating and relating the amount of energy consumed and resulting negative environmental consequences if every student living on-campus at Texas State left their laptop chargers plugged in all year (Appendix A). Also interesting, more students report never adjusting their thermostat before leaving for the weekend (67.6%), than never adjusting prior to going out for the evening (63.8%) or before class (55.7%). This may be contributable to the vast majority (89.9%) of respondents living with at least one other person – limiting their ability to adjust the thermostat, since someone else is in the room.

Half of respondents experience limited to no problems on temperature agreement with roommate(s). In light of the conclusion that thermostats remain generally untouched, presumably not many arguments take place on the thermostat controls. However, increasing the temperature to an optimal energy conservation setting could lead to disagreements, since 70-71°F is the reported ideal temperature for the majority, and a setting of 76°F promotes conservation (or in the case of Hall A, 75°F).

More students (46.7%) reported that receiving a check at the end of the semester with a reimbursement equivalent to the energy savings experienced in their room would influence their than reported paying a monthly electric bill would influence their habits (30.7%). This does not seem to agree with the loss aversion theory, that people are more sensitive to losing money than gaining money, perhaps because many parents are footing the bills rather than the students.

Chi-square tests indicate that a student who does not adjust their thermostat on a daily basis is significantly more likely to have never viewed the electric bill at their previous place of residence. Whether a student adjusts their thermostat at least once daily is also associated with whether a student adjusted the thermostat before Spring Break; adjusting the thermostat at least once a day indicates adjustment also occurred before Spring Break. Students are also more likely to adjust the thermostat more than once a day if they have at least some familiarity with the amount of energy consumed by different device and appliances. If a student believes the thermostat settings have any effect on the University's carbon footprint, they are also likely to believe it has some degree of impact on the University's electric bill.

Though not directly related to energy conservation, the low reported rate of recycling in individual rooms –even though recycling is offered in both of these buildings – relates to environmental consciousness. Yet a high percent report recycling on campus. This trend may lend support to the lack of social influences or peer pressure within individuals rooms as compared to being on-campus.

RESEARCH QUESTION #2:

Reported vs. Actual Thermostat Habits & Settings

The second research question in study seeks to identify if a difference exists between reported and actual thermostat habits and behaviors and the possible effects of on energy consumption. Based on previous research in the literature, those without a financial incentive to conserve energy are generally not motivated to conserve energy. Based on the action-value gap theory, I hypothesized a difference between reported and actual thermostat preferences and behaviors.

Nearly the same percentage of students report their ideal room temperature (close-ended question) falls between 68°F to 73°F as do on a free-response post-survey question asking the most recent thermostat set point (81% and 82.1%, respectively). This indicates that the sample population chooses to set the thermostats to their ideal temperature, and is also supported with a statistically significant t-test (Table 6).Thermostat data is only available for Hall A, but the majority of responses (84%) across both surveys come from Hall B Jacinto residents. Thus, it seems reasonable to believe that the same thermostat settings observed in Hall A also occur in Hall B.

Table 9 shows a couple of illogical mean thermostat set points and actual room temperatures in Hall A, suggesting some degree of inaccuracy with the thermostats and/or HVAC systems. I asked the residence hall director to recruit two or three students to record their room’s thermostat set point at several points over the course of two days, to account for thermostat validity. However, this effort did not come to fruition because the director never sent out the email to residents, even after several requests.

Average energy consumption (kWh) in Hall A on Saturdays during this two-month study period is significantly different compared to all other days of the week combined. This may be contributable to students leaving the residence hall, thus consuming less energy. However, this trend may also be attributable to a larger operational change that might occur on the weekends.

Visually analyzing data from Hall A (Table 9), of students who participated in one of the surveys, observed temperatures more or less agree with the reported behaviors. A slightly higher mean temperature for Spring Break appears to indicate that some students did increase their thermostats before leaving for the break. However, Table 10 tests actual observations of thermostat set point averages for each day during the Spring Break and Pre-Intervention periods, to see if students adjusted their thermostats before Spring Break. Only 6% of the students in Hall A increased their thermostats before Spring Break. An additional 24 rooms (28.6%) also adjusted their thermostat, but set points were lower during Spring Break than Pre-Intervention, suggesting energy conservation behaviors were not displayed. According to the survey, about 33% of respondents adjusted the thermostat. This data suggests 34.6% adjusted their thermostat, though not necessarily in the direction of energy conservation. Therefore, Question #30 should have explicitly addressed "an adjustment to conserve energy."

RESEARCH QUESTION #3:

Attitudes, Environmental Consciousness & Behaviors

The ideal room temperature and set point temperatures are relatively low, yet it seems contradictory that over half of respondents align with an environmentally conscious view. This suggests the presence of the action-value gap, unless students fail to make the connection between temperature settings and negative environmental consequences. However, 90% of students stated they believe the thermostat settings had at least some impact on the University's carbon footprint, and nearly 95% believe the settings impact the University's electricity bill to some extent or greater. This suggests awareness of the relationship between temperature settings, negative environmental consequences, and financial costs, yet students' actions fail to align with this acknowledgement.

In a linear regression model, the selected energy-related behavior variables (Table 12) describe approximately 25% of the energy conservation opinion leader index. The less time a student has lived in a residence hall, the younger they are, the longer they have been in college, the fewer number of bedrooms in their childhood homes, the less amount of thought given to energy consumption, and the less familiar they are with how much energy various devices consume predicts a weaker degree of environmental consciousness. This regression fails to support the hypothesis; students' reported views and attitudes align with their reported behaviors. In this instance, reported energy-related behaviors do align with a weaker environmental consciousness.

In a similar linear regression model, the thermostat-related behavior variables describe approximately 15% of the NEP Index (Table 9). Those who are less environmentally conscious possessed a greater degree of temperature control in their previous living situation and rarely adjust their thermostats on daily basis, but if the room temperature is uncomfortable they often try to mediate the problem by adjusting the thermostat.

CONCLUSION

Students rarely touch their thermostats; however when they are unconformable with the room temperature, adjusting the thermostat is the most frequent solution. According to the Hall A temperature data, set point temperatures across both the pre- and post-intervention time periods averaged 65.31°F, while the actual room temperature averaged 71.46°F. Students receive notification at the beginning of the semester about the thermostat restrictions, ranging from 68°F to 75°F. This is important for two reasons. First, students in Hall B do not have restricted thermostats, so adjusting the thermostat to the same set point as observed in Hall A would drastically increase costs and negative environmental consequences due to the HVAC system actually kicking on all the way to 65 degrees and because of a much larger occupancy. Secondly, students report rarely adjusting their thermostats on a daily basis, as is supported with the dataset from Hall A. Thus, consciously choosing to set the thermostat to 71°F, or lower, wastes energy and money, compared to a setting of 75°F or higher. Hall B residents have the ability to turn their air conditioning above 75°F, since there are no restrictions on their thermostats, creating a greater potential for financial savings exists, especially given the size and volume difference between the halls.

On an average day during the Spring Break period, Hall A used 715.814 kWh, compared to an average day (of all four other periods averaged) of 967.535 kWh, which is considerably less energy consumption. At a rate of .075 cents per kWh, this equates to $53.69 spent on energy daily during the 10-day long Spring Break period (a time of relative conservation) or about 64 cents per student, per day. Thus, the University paid $536.86 for electricity in Hall A during the 10-day Spring Break period –the smallest coed residence hall on campus, when presumably students were away on vacations and the University was in conservation mode. Less than a third of students (between both residence hall's respondents), reported adjusting their thermostat prior to leaving for this break, suggesting room for additional financial savings, especially in the larger residence halls, such as Hall B. A targeted campaign in the residence halls could generate substantial savings.

During the Pre-Intervention period, Hall A used an average of 892.04 kWh, or $66.903 per day, and $936.642 for the 14-day period. During the Intervention period, Hall A used an average of 990.54 kWh per day, or $74.29 each day. Multiplied by a 12-day, energy consumption cost $891.48, again, for the smallest residence hall on campus, with restricted thermostats. The Post-Intervention period used an average of 970.77 kWh per day, or $78.81 per day, and $1,019.31 over the two-week period. The End of Year period maintained the highest average, an average of 1041.75 kWh per day, costing about $4 per day more than the Intervention period. This may be attributable to students spending more time in their rooms, since classes are no longer in session and warmer temperatures. However, if these costs are associated with one of the smallest residence halls on campus, with restricted thermostats, large savings potential exist through further outreach not only in Hall A, but particularly in Hall B, where thermostats are free-range.

LIMITATIONS & METHODOLOGICAL WEAKNESSES

Several methodological weaknesses were discovered during the analysis stage of this thesis. Additional demographic measures should have appeared on both surveys, such as race, area grew up in (i.e. urban city, suburban, rural), and political orientation (i.e. liberal, conservative, or moderate). After further reflection, the survey should have focused more on questions explicitly related to thermostats and perceived levels of control. For example, including a question that asked "What is the coolest temperature you believe your room reaches" would have proved useful in understanding perceived respondent efficacy with respect to thermostat behavior. Similarly, a couple of questions should have been included on the pre-survey to gain a true understanding of the student's prior knowledge, in addition to also including the free-response question of the most recent thermostat set point. A free-response question on the pre-survey should have also captured what exactly would motivate students to conserve energy in order to better tailor the campaign to their desires and needs.

Question #46 on the post-survey accidentally included a sixth answer choice, 'frequently,' that was not noticed until data processing. This answer choice only received four responses, and was combined with the fifth answer choice 'A lot' in coding the variable. Question #37 on the post-survey also had a mistake in the answer choices. Answer choice 'better' (value of five) should have been removed because there was no identical opposite answer choice (such as 'worse'), giving an uneven response spectrum on either side of the neutral answer.

Unfortunately, both the pre and post-surveys resulted in lower than expected response rates (10.71% and 6.5%, respectively). Several explanations help describe this occurrence. For one, the researcher failed to discover, until after sending the initial pre-survey email, that the DHRL recently distributed an end-of-the-semester survey. Obtaining agreeable response rates to surveys on university campuses continues to increase in difficulty (Kosky et al. 2015). Moving survey distribution occurred to the fall semester, or simply earlier in the spring semester, may have also increased response rates.

As a whole, universities are often over-surveyed, and as a result, many campus officials consider a 20% survey response rate normal (Lipka 2011). Low response rates give rise to non-response error and response validity in the data (Dillman 2000; Mitra, Jain Shukla, Robbins, 2008). As mentioned earlier, one individual submitted two post-surveys with differing response choices for identification variables (age and number of bedrooms in home grew up in). The estimated survey length time of 20 minutes may have also deterred participants, since Fan and Yan (2010) denote 13 minutes or less as the ideal time length for this population.

For a higher response rate that better represented the target population, it may have been useful to create a QR code link to the survey and slip a piece of paper in each student's mailbox with instructions on how to complete the survey. Going to door-to-door for short question and answers sessions with residents could have also supplemented lack of responses, and increased the level of awareness spread. However, this method may have increased the amount of contamination during the study periods. In other words, if I had executed face-to-face surveys during the Pre-Intervention period, students' behaviors might have changed prior to the Intervention period.

The sample size limited the analysis process, such as crosstabs necessitating the use of Fischer's exact test rather than chi-square. Similarly, measuring the effect of opinion leaders on neighbors with opinion leader indices and room numbers was not feasible. The adjusted timeline also complicated analysis comparisons during the Spring Break the majority of students are away from campus.

The differing speed and level of assistance from the residence hall directors unexpectedly impacted the study. While Residence Hall Director B was quick to hang and distribute most of the requested materials, Hall A's residence director was not as timely. Despite going into Hall A and contacting the director several times to hang the campaign materials throughout the building, I could only locate one area with the signs (the front lobby area bulletin board). Further, the 11" x 17" poster hung near the front door of the hall was removed after only four or five days. There was also an unsuccessful attempt to recruit volunteers from Hall A to record set point thermostat temperatures to validate the downloaded data. Testing the effect of residence hall director's authority and influence against that of residence hall assistants (RA's) may have been insightful. Perhaps social diffusion would have been successful through RA's, since they are generally closer in age to the students than the directors.

FINANCIAL & ENVIRONMENTAL IMPLICATIONS

Table 16 takes the data from Table 8 and applies a rate of $.075 to each study period's average daily energy consumption (kWh). Though the average cost per student per day seems minimal, using an average of $0.824 per student per day (average of the averages), over the entire spring semester, the kWh in Hall A divided by the number of students is just shy of $100. While students are not capable of affecting the entire kWh used in the building (i.e. the bathroom, hallway, or safety lights), based on the few students using thermostat settings that promote energy conservation, or fail to unplug devices before leaving the room, there is room for savings.

On average, one thirty-day month in the springtime Residence Hall A uses 27,665.76 kWh and emits 19.1 metric tons of carbon dioxide. According to the EPA's Greenhouse Gas Equivalencies Calculator, this is equivalent to an average passenger vehicle driving 45,421 miles annually; sending 6.8 tons of waste to the landfill annually;

or consuming 2,147 gallons of gasoline annually. Nearly 500 tree seedlings grown for ten years are necessary to offset these emissions. These environmental consequences are for one month of energy consumption in the third smallest (of 24) residence hall on campus. Multiply the average across the two-month (62 days) study period of this research, and these figures double to 57,176 kWh and 39.4 metric tons of carbon dioxide.

Table 16. Financial Implications for Energy Consumed in Residence Hall A

Study Period	Avg. kWh	Avg. Cost per Day	Avg. Cost for Study Period	Avg. Cost per Student per Day	Avg. Cost per Student for Study Period
SB	715.81	$53.69	$536.86	$0.64	$6.39
All Other	967.54	$72.57		$0.86	
Pre-IV	892.04	$66.90	$936.64	$0.80	$11.15
All Other	934.35	$70.08		$0.83	
IV	990.54	$74.29	$891.49	$0.88	$10.61
All Other	906.81	$68.01		$0.81	
Post-IV	970.77	$72.81	$1,019.31	$0.87	$12.13
All Other	911.97	$68.40		$0.81	
EOY	1041.75	$78.13	$937.58	$0.93	$11.16
All Other	899.63	$67.47		$0.80	

POLICY IMPLICATIONS

The conclusions gathered from this study present an opportunity to provide policy implications to the University and to the Texas Legislature. Texas Senate Bill 5 requires all public buildings, including universities, to reduce electricity consumption by five percent annually in existing facilities between 2011 and 2021 (U.S. DOE 2014). In the ten year time period, this means cutting electricity usage in half. Since technology is a function of humans, in that humans' ability to create, adopt, and maintain the technology, which influences its effectiveness, technological impacts on reduction are limited. Thus, the requirement should be rewritten so that universities and other public schools must invest a certain percent of the savings recuperated from energy savings into educational outreach. With the political make-up of the current Texas Legislature, this may not be realistic. However, it is feasible to include a similar policy on the university level. Texas State University should consider investing one or two percent of the savings generated from technological improvements into developing and promoting education and outreach for on-campus residents.

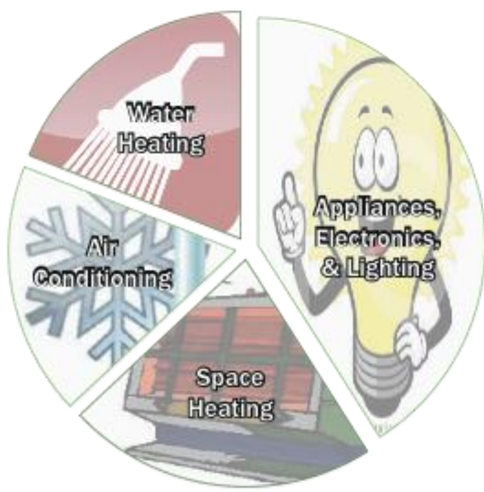
Integrating an educational outreach policy increases engagement and thus eases achieving energy reduction beyond the scope of technology through behavioral changes. Changing behavioral habits towards energy conservation in residence halls and means savings are generated when students move out of the residence halls, to apartments presumably within the city of San Marcos. While on an individual level, energy conservation is influential because of financial savings, on a structural level –such as at the University or within the city of San Marcos – conservation is beneficial to the environment and institution itself, through decreased greenhouse gas emissions and water usage, ultimately increasing the livability of the institution.

APPENDIX SECTION

APPENDIX A: Unplug Flyer

APPENDIX B: Energy Habits Flyer

THINK YOUR ENERGY HABITS DON'T MATTER?

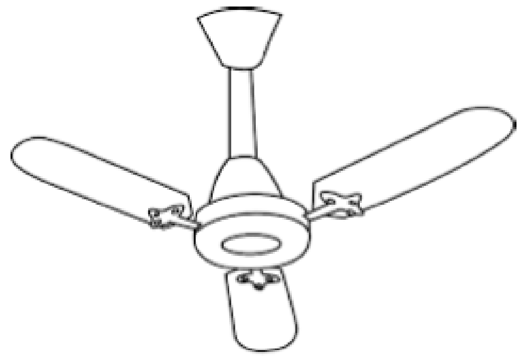


THINK AGAIN!

The average Texas household's electric consumption rate by end use is shown above. Heating & air conditioning costs can account for up to 50% of usage during peak season. SETTING THE A/C TO 78° IS OPTIMAL...like setting a car on cruise control across the flat Midwest. Lowering the temperature 5° can cost up to 40% more!

BOBCATS SAVE ENERGY

APPENDIX C: Fan Flyer



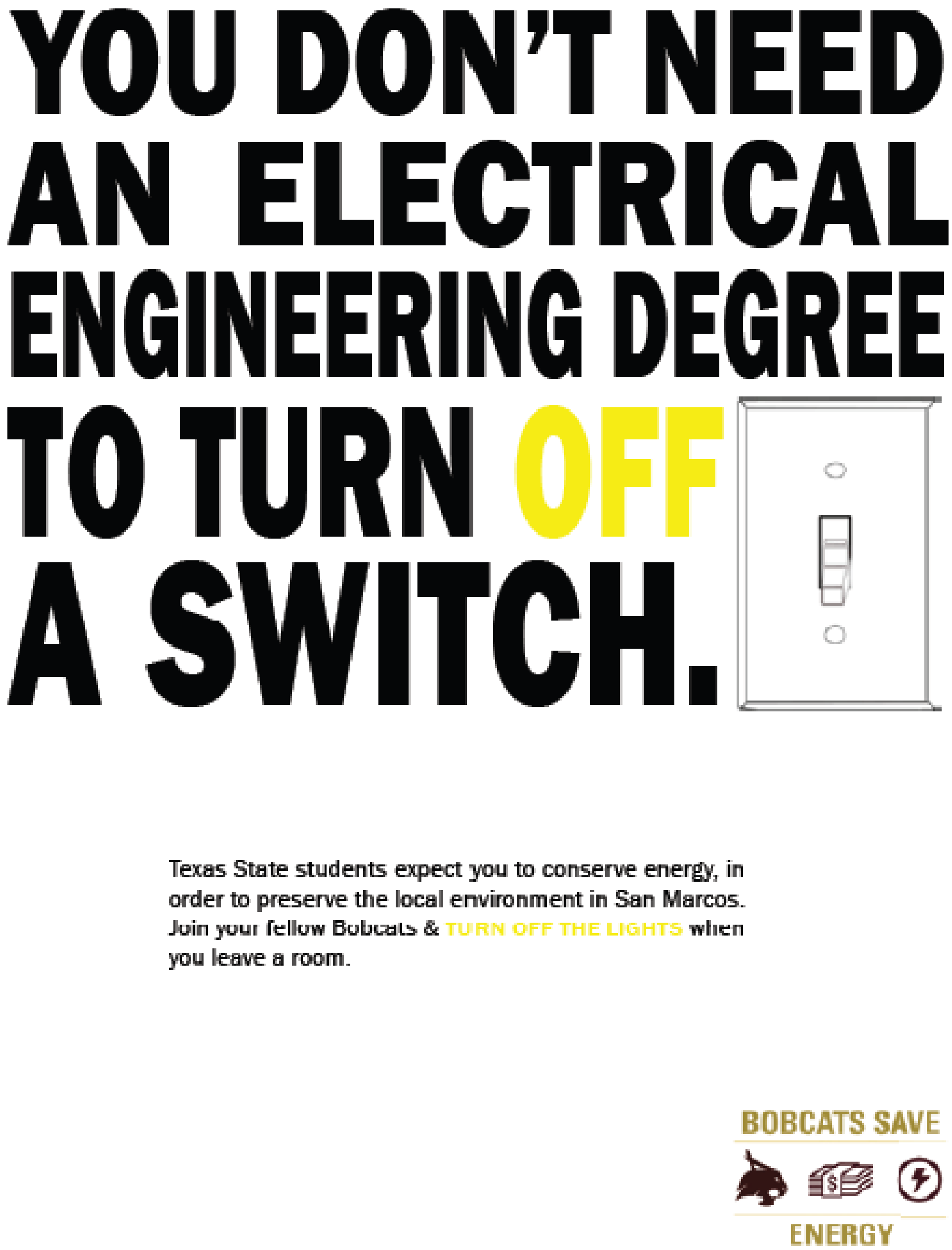
FANS DON'T COOL A ROOM. THEY JUST COOL YOUR SKIN.

TURN OFF FANS

WHEN YOU'RE AWAY.

BOBCATS SAVE ENERGY

APPENDIX D: Light Switch Flyer



APPENDIX E: Tip Sheet Poster

SPRING INTO SUNSHINE & SHOWERS WITH ENERGY SAVINGS

WHAT YOU CAN DO

In warmer weather, set the A/C to at least 76°F. Acclimate yourself by increasing the temperature 1 degree each week.

Turn off the lights when you leave a room.

Take the stairs instead of the elevator. An elevator can use up to 20,000 kWh/year, enough to power 2 homes for a year.

Raise the thermostat 1-2 degrees before leaving the room for an extended period.

Replace incandescent light bulbs with compact fluorescent bulbs.

Take the stairs instead of the elevator. An elevator can use up to 20,000 kWh/year, enough to power 2 homes for a year.

Dress appropriately & comfortably for the weather. Change clothes before changing your thermostat.

Power down & unplug appliances, electronics, & chargers when not in use.

Take the stairs instead of the elevator. An elevator can use up to 20,000 kWh/year, enough to power 2 homes for a year.

Use a fan to cool you directly. Cranking down the A/C will not cause the room to cool faster.

Use power management settings, such as standby mode, on your computer.

BOBCATS SAVE ENERGY

APPENDIX F: Email with Tip Sheet Attachment

Subject: The Power of You

Body:

Join your fellow Bobcats in Beretta Hall in helping protect the local San Marcos environment by conserving energy. Texas State students pride themselves in regularly engaging in energy saving behaviors. You have the power to take these initiatives, too! Join in by turning off lights, unplugging electronics, and raising the thermostat 1-2 degrees when you leave your room. For other ideas and energy conservation tips, see the poster attached to this email.

Bobcats save energy. Will you lend a helping paw?

APPENDIX G: Survey Consent Form

BOBCATS SAVE ENERGY

You are being asked to participate in this survey as part of a research project to understand energy consumption behaviors and environmental attitudes of college students living in university housing. This research is being conducted by graduate student, Madelyn Morgan, madelynm@txstate.edu, under faculty sponsor Dr. Chad Smith, clsmith@txstate.edu (512-245-8453).

This survey is similar, but separate from an earlier survey distributed in March. You may complete this survey regardless of participation in the first survey.

Please proceed ONLY if you are a student at Texas State University living in university-sponsored housing.

Your participation is voluntary, and refusal to participate will involve no penalty or loss of benefits to which you are otherwise entitled. You may discontinue participation or skip a survey item at any time without penalty or loss of benefits to which you are otherwise entitled.

No serious risks to the participant have been identified. All survey responses are confidential, and at no point will your name be recorded. Any information on individual room usage and responses will be kept confidential at all times. Survey results will be stored in a password-protected file and destroyed after three years. All data collected will be aggregated, and results will not include any individual level data. Only the researcher and faculty sponsor will have access to the surveys.

Below is an example of a survey question you will see:

How often do you and your roommate(s) agree the temperature of your room is comfortable?

Never | Rarely | Sometimes | Often | Always | Not applicable

This project #2015T4234 was approved by the Texas State IRB on March 4, 2015. Pertinent questions or concerns about the research, research participants' rights, and/or research-related injuries to participants should be directed to the IRB chair, Dr. Jon Lasser (512-245-3413 - lasser@txstate.edu) and to Becky Northcut, Director, Research Integrity & Compliance (512-245-2314 - bnorthcut@txstate.edu).

A summary of the findings will be provided to participants upon completion of the study, if requested. To access results of the study, contact Madelyn Morgan (madelynm@txstate.edu).

Upon completion of this survey, you may voluntarily leave an email address to be entered into a raffle for a chance to win 1 of 2 Amazon FireTV Sticks. Your email address will not be associated with any of your responses.

By proceeding to the next page, you are giving your consent to participate in this study. The survey that follows include roughly 50 questions. It should take approximately 20 minutes to complete.

○ Agree

APPENDIX H - Surveys

Q56 [CONSENT FORM (See Appendix G)]
- ❍ Agree (1)

Q1 Select your year in school.
- ❍ First year (1)
- ❍ Second year (2)
- ❍ Third year (3)
- ❍ Fourth year (4)
- ❍ Graduate student (5)

Q2 Select your gender.
- ❍ Male (1)
- ❍ Female (2)

Q3 How old are you?
- ❍ 17 or younger (1)
- ❍ 18 (2)
- ❍ 19 (3)
- ❍ 20 (4)
- ❍ 21 (5)
- ❍ 22 (6)
- ❍ 23 or older (7)

Q4 How many people do you share a room with? Roommate defined as someone you share sleeping quarters with. Suitemate defined as someone in a separate, but attached room. Please select all that apply.
- ❑ I live alone (1)
- ❑ 1 roommate (2)
- ❑ 1 suitemate (3)
- ❑ 2 suitemates (4)
- ❑ 3 suitemates (5)

Q5 How many semesters (including the current) have you lived in a residence hall on campus?
- ❍ 1 (1)
- ❍ 2 (2)
- ❍ 3 (3)
- ❍ 4 (4)
- ❍ 5 (5)
- ❍ 6 or more (6)

Q6 How many bedrooms did the home you spent most of your childhood in have?
- ❍ 0 bedrooms/studio apartment (1)
- ❍ 1 bedroom (2)
- ❍ 2 bedrooms (3)
- ❍ 3 bedrooms (4)
- ❍ 4 bedrooms (5)
- ❍ 5 or more (6)

Q7 How much control did you have over the temperature of your living space before coming to Texas State?
- ❍ None at all (1)
- ❍ Not much (2)
- ❍ Some (3)
- ❍ A fair amount (4)
- ❍ A lot (5)

Q8 How often did you look/see the electric bill at your previous place of residence?
- ❍ Not at all (1)
- ❍ Not much (2)
- ❍ Some (3)
- ❍ A fair amount (4)
- ❍ A lot (5)

Q9 Please select your residence hall:
- ❍ Hall 1
- ❍ Hall 2

Q10 Please enter your room number.

Q11 On average, how often are the environmental conditions in your room:

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Hot (1)	❍	❍	❍	❍	❍
Cold (2)	❍	❍	❍	❍	❍
Stuffy (3)	❍	❍	❍	❍	❍
Damp/Humid (4)	❍	❍	❍	❍	❍
Drafty (5)	❍	❍	❍	❍	❍
Dry (6)	❍	❍	❍	❍	❍

Q12 How often do you feel your heating or air conditioning DOES NOT work?
- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Often (4)
- ❍ Always (5)

Q13 How often do you and your roommate(s) agree the temperature of your room is comfortable?
- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Often (4)
- ❍ Always (5)
- ❍ Not applicable (6)

Q14 What is your ideal room temperature setting?
- 68-69°F (1)
- 70-71°F (2)
- 72-73°F (3)
- 74-75°F (4)
- 76-77°F (5)
- 78-79°F (6)
- 80° or higher (7)
- Not sure (8)

Q15 On a daily basis, how often do you adjust the thermostat in your room?
- Never (1)
- Once a day (2)
- 2-3 times a day (3)
- 4-5 times a day (4)
- More than 5 times a day (5)

Q58 To your best ability, please enter the temperature you most recently set your thermostat.[6]

Q59 Over the last two weeks, did you notice any signage or outreach materials related to energy conservation throughout your residence hall?
- Yes (1)
- No (2)

If No Is Selected, Then Skip To Q60...

Q65 How much more thought do you give to the amount of energy consumed in your room since the educational outreach campaign?
- None at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q60 For the following questions, please select the answer you believe is correct:
Q61 Leaving the fan on in a room will lower the temperature of a room.
- True (1)
- False (2)

Q62 Setting the A/C at or above 78°F is optimal for energy conservation and financial savings.
- True (1)
- False (2)

Q63 Leaving electronics and appliances plugged in when not in use wastes electricity.
- True (1)
- False (2)

[6] Text in red only appeared on the Post-Survey.

Q64 The average amount of energy used in my residence hall is ultimately reflected in the housing rate I pay.

- ❍ True (1)
- ❍ False (2)

Q57 Did you participate in Part I of this survey in the month of March?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Unsure (3)

If Yes Is Selected, Then Skip To Q21

Q16 Consider the last two weeks of time. When the temperature in your room is too hot or cold, how often do you take the following actions?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)	Not applicable (6)
Open or close the door (1)	❍	❍	❍	❍	❍	❍
Open or close the window (2)	❍	❍	❍	❍	❍	❍
Adjust the heater or AC (3)	❍	❍	❍	❍	❍	❍
Turn computer on or off (4)	❍	❍	❍	❍	❍	❍
Change clothing (5)	❍	❍	❍	❍	❍	❍
Turn lights on or off (6)	❍	❍	❍	❍	❍	❍
Turn electric equipment on or off (7)	❍	❍	❍	❍	❍	❍
Eat or drink something warm or cold (8)	❍	❍	❍	❍	❍	❍
Turn a fan on or off (9)	❍	❍	❍	❍	❍	❍
Move to another area of your room (10)	❍	❍	❍	❍	❍	❍
Leave your room to go to another room or common area (11)	❍	❍	❍	❍	❍	❍
Leave your residence hall building altogether (12)	❍	❍	❍	❍	❍	❍
Reduce or increase your activity level (13)	❍	❍	❍	❍	❍	❍
Complain to the RA or housing office (14)	❍	❍	❍	❍	❍	❍
Take no action (15)	❍	❍	❍	❍	❍	❍
Other (16)	❍	❍	❍	❍	❍	❍

Q19 How frequently do the actions listed in the above question improve the comfort conditions in your room?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Often (4)
- ❍ Always (5)

Q20 How often does the weather influence the actions you take to adjust the comfort conditions in your room?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Often (4)
- ❍ Always (5)

Q21 During the last two weeks, when you leave your room FOR CLASS, how often have you performed the following tasks?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)	Not Applicable (6)
Turn off overhead lights (1)	❍	❍	❍	❍	❍	❍
Turn off your computer (2)	❍	❍	❍	❍	❍	❍
Charge your laptop [battery] (3)	❍	❍	❍	❍	❍	❍
Unplug your computer/laptop charger (4)	❍	❍	❍	❍	❍	❍
Unplug your phone charger (5)	❍	❍	❍	❍	❍	❍
Leave the TV on (6)	❍	❍	❍	❍	❍	❍
Leave a fan running (7)	❍	❍	❍	❍	❍	❍
Leave a lamp on (8)	❍	❍	❍	❍	❍	❍
Adjust the thermostat or heater controls (9)	❍	❍	❍	❍	❍	❍
Other (10)	❍	❍	❍	❍	❍	❍

Q20 During the last two weeks, when you leave your room TO GO OUT FOR THE EVENING, how often have you performed the following tasks?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)	Not Applicable (6)
Turn off overhead lights (1)	❍	❍	❍	❍	❍	❍
Turn off your computer (2)	❍	❍	❍	❍	❍	❍
Charge your laptop [battery] (3)	❍	❍	❍	❍	❍	❍
Unplug your computer/laptop charger (4)	❍	❍	❍	❍	❍	❍
Unplug your phone charger (5)	❍	❍	❍	❍	❍	❍
Leave the TV on (6)	❍	❍	❍	❍	❍	❍
Leave a fan running (7)	❍	❍	❍	❍	❍	❍
Leave a lamp on (8)	❍	❍	❍	❍	❍	❍
Adjust the thermostat or heater controls (9)	❍	❍	❍	❍	❍	❍
Other (10)	❍	❍	❍	❍	❍	❍

Q21 On average, when you leave your room to go off-campus FOR THE WEEKEND, how often do you perform the following tasks?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)	Not Applicable (6)
Turn off overhead lights (1)	❍	❍	❍	❍	❍	❍
Turn off your computer (2)	❍	❍	❍	❍	❍	❍
Charge your laptop [battery] (3)	❍	❍	❍	❍	❍	❍
Unplug your computer/laptop charger (4)	❍	❍	❍	❍	❍	❍
Unplug your phone charger (5)	❍	❍	❍	❍	❍	❍
Leave the TV on (6)	❍	❍	❍	❍	❍	❍
Leave a fan running (7)	❍	❍	❍	❍	❍	❍
Leave a lamp on (8)	❍	❍	❍	❍	❍	❍
Adjust the thermostat or heater controls (9)	❍	❍	❍	❍	❍	❍
Other (10)	❍	❍	❍	❍	❍	❍

Q22 On average, to what degree does your roommate prevent your ability to take any of the above action(s) related to energy usage for the following situations?

	Not at all (1)	Not much (2)	Some (3)	A fair amount (4)	A lot (5)	Not applicable (6)
Leaving for class (1)	❍	❍	❍	❍	❍	❍
Leaving to go out for the evening (2)	❍	❍	❍	❍	❍	❍
Leaving for the weekend (3)	❍	❍	❍	❍	❍	❍

Q26 Do you have a mini fridge in your room?
- ❍ Yes (1)
- ❍ No (2)

Answer If ‘Do you have a mini fridge in your room?’ ‘Yes’ Is Selected, Ask Q24

Q23 Did you clean out the contents and unplug your mini-fridge before you left for Winter Break?
- ❍ Yes (1)
- ❍ No (2)
- ❍ Not applicable (3)

Answer If ‘Did you clean out the contents and unplug your mini-fridge before you left for Winter Break?’ ‘Yes’ Is Selected

Q24 You cleaned out and unplugged your mini-fridge before Winter Break. Why?
- ❍ Residence hall personnel told me to (1)
- ❍ To save energy (2)
- ❍ To prevent food spoilage/smell (3)
- ❍ Other (4) ____________________

Answer If ‘You have a mini-fridge in your room, did you clean out the contents and unplug the appliance before you left for Winter Break?’ ‘No’ Is Selected

Q25 You did not clean out and unplug your mini-fridge before Winter Break. Why not?
- ❍ I forgot (1)
- ❍ I didn't want to (2)
- ❍ I thought my roommate would do it (3)
- ❍ Other (4) ____________________

Answer If ‘Do you have a mini fridge in your room?’ ‘Yes’ Is Selected

Q27 Did you clean out the contents and unplug your mini-fridge before you left for Spring Break?
- ❍ Yes (1)
- ❍ No (2)

Answer If ‘Did you clean out the contents and unplug your mini-fridge before you left for Spring Break?’ ‘Yes’ Is Selected

Q28 You cleaned out and unplugged your mini-fridge before Spring Break. Why?
- ❍ Residence hall personnel told me to (1)
- ❍ To save energy (2)
- ❍ To prevent food spoilage/smells (3)
- ❍ Other (4) ____________________

Answer If ‘Did you clean out the contents and unplug your mini-fridge before you left for Spring Break?’ ‘No’ Is Selected

Q29 You did not clean out and unplug your mini-fridge before Spring Break. Why not?
- I forgot (1)
- I didn't want to (2)
- One or more persons in my room stayed on-campus (3)
- Other (4)

Q30 Did you adjust or turn off your thermostat before you left for Spring Break?
- Yes (1)
- No (2)
- 1 or more persons in my room did not leave (3)

Q31 During the last two weeks, on average, how often have you unplugged the following devices from the wall? Select all that apply:

	Device		
	Phone charger (1)	Laptop (2)	Tablet (3)
After device is fully charged (1)	❑	❑	❑
Every time I leave my room (2)	❑	❑	❑
Before I go to class (3)	❑	❑	❑
Every few days (4)	❑	❑	❑
Once a week (5)	❑	❑	❑
If I am going to be away from my room longer than normal (6)	❑	❑	❑
When I go on a trip (7)	❑	❑	❑
Never (8)	❑	❑	❑
Not applicable (9)	❑	❑	❑

Q32 During the last two weeks, on average, how many hours a day is each device plugged into its charger? Consider if you charge your device while you sleep or study in your room. Leave at 0 if you do not possess the device.

______ Phone (1)
______ Laptop (2)
______ iPad or tablet (3)

Q33 During the week (Monday thru Thursday), on average, how much time do you spend in the common areas of your residence hall?
- None at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)
- Not applicable (6)

Q34 During the weekend (Friday thru Sunday), on average, how much time do you spend in the common areas of your residence hall?
- ❍ None at all (1)
- ❍ Not much (2)
- ❍ Some (3)
- ❍ A fair amount (4)
- ❍ A lot (5)
- ❍ Not applicable (6)

Q35 How much control do you have over the consumption of electricity in the common areas of your residence hall?
- ❍ None at all (1)
- ❍ Not much (2)
- ❍ Some (3)
- ❍ A fair amount (4)
- ❍ A lot (5)
- ❍ Not applicable (6)

Q36 In general, if you see the TV on in a common area, but no one is in the room, do you turn off the TV?
- ❍ Yes (1)
- ❍ No (2)
- ❍ Not applicable (3)

Q37 In general, how do the thermal comfort conditions in the common areas compare with the conditions in your room?
- ❍ Much worse (1)
- ❍ Somewhat worse (2)
- ❍ About the same (3)
- ❍ Somewhat better (4)
- ❍ Better (5)
- ❍ Much better (6)
- ❍ I don't know (7)

Q38 Please choose how much time you spend in your room on a normal school day (Monday-Friday) during the following times:

	None at all (1)	Not much (2)	Some (3)	A fair amount (4)	A lot (5)
Midnight - 3 AM (1)	❍	❍	❍	❍	❍
3 AM - 6 AM (2)	❍	❍	❍	❍	❍
6 AM - 9 AM (3)	❍	❍	❍	❍	❍
9 AM - 12 PM (4)	❍	❍	❍	❍	❍
12 PM - 3 PM (5)	❍	❍	❍	❍	❍
3 PM - 6 PM (6)	❍	❍	❍	❍	❍
6 PM - 9 PM (7)	❍	❍	❍	❍	❍
9 PM - Midnight (8)	❍	❍	❍	❍	❍

Q39 Please specify how many of the following devices are located in your room. Include roommates'/suitemates' devices if you are aware of that information.

	0 Devices (1)	1 Devices (2)	2 Devices (3)	3 Devices (4)	4+ Devices (5)
Mini refrigerator (2.5 cubic ft) (1)	❍	❍	❍	❍	❍
Mini refrigerator (4.5 cubic ft) (2)	❍	❍	❍	❍	❍
Coffee maker or electric tea pot (3)	❍	❍	❍	❍	❍
Laptop computer (4)	❍	❍	❍	❍	❍
Desktop computer (5)	❍	❍	❍	❍	❍
External hard drive (6)	❍	❍	❍	❍	❍
iPad or tablet (7)	❍	❍	❍	❍	❍
Printer (8)	❍	❍	❍	❍	❍
TV (9)	❍	❍	❍	❍	❍
DVD or Blu-Ray player (10)	❍	❍	❍	❍	❍
Sound system or iPod dock (11)	❍	❍	❍	❍	❍
Plug-in lamp (12)	❍	❍	❍	❍	❍
Desk or window fan (13)	❍	❍	❍	❍	❍
Gaming system (14)	❍	❍	❍	❍	❍
Other (15)	❍	❍	❍	❍	❍

Q40 How often do you wash a load of laundry?
- ❍ Daily (1)
- ❍ 2-3 Times a Week (2)
- ❍ Once a Week (3)
- ❍ 2-3 Times a Month (4)
- ❍ Once a Month (5)
- ❍ Less than Once a Month (6)
- ❍ Never (7)

Q41 How often do you engage in the following actions?

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Always (5)
Use cold water setting on washing machine (1)	❍	❍	❍	❍	❍
Put your clothes in dryer after washing them (2)	❍	❍	❍	❍	❍
Use a drying rack (3)	❍	❍	❍	❍	❍
Recycle in your room (4)	❍	❍	❍	❍	❍
Recycle on campus (5)	❍	❍	❍	❍	❍
Take reusable bags to the store (6)	❍	❍	❍	❍	❍

Answer If ‘Did you participate in Part I of this survey in the month of March?’ ‘Yes’ Is Not Selected

Q42 How often do you give thought to the amount of energy you are consuming in your room?

- None at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q43 If you had to pay for a monthly electric bill for your room (on top of your boarding costs), how much do you think you would adjust your behaviors?

- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q44 If you received a check at the end of semester, reimbursing you with a payment equivalent to energy savings experienced in your room, to what degree do you think you would adjust your behaviors?

- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q45 When you move out of the residence hall, how much do you expect your energy consumption habits and behaviors to change?

- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q46 To what degree do you believe the thermostat setting impacts the university’s carbon footprint?

- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)
- Frequently (6)

Answer If ‘Did you participate in Part I of this survey in the month of March?’ ‘Yes’ Is Not Selected

Q47 In your own words, explain a carbon footprint.

Q48 To what degree do you believe the thermostat setting impacts the university’s electricity bill?

- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q49 Have you heard of ‘vampire power’?
- Yes (1)
- No (2)
- Not sure (3)

Q50 How familiar are you with the energy consumption of different electronic devices/appliances?
- Not at all (1)
- Not much (2)
- Some (3)
- A fair amount (4)
- A lot (5)

Q51 To what extent do you agree or disagree with each of the following statements below?

	Strongly Agree (1)	Agree (2)	Unsure (3)	Disagree (4)	Strongly Disagree (5)
We are approaching the limit of the number of people the Earth can support. (1)	❍	❍	❍	❍	❍
Humans have the right to modify the natural environment to suit their needs. (2)	❍	❍	❍	❍	❍
When humans interfere with nature it often produces disastrous consequences. (3)	❍	❍	❍	❍	❍
Human ingenuity will insure that we do not make the Earth unlivable. (4)	❍	❍	❍	❍	❍
Humans are seriously abusing the environment. (5)	❍	❍	❍	❍	❍
The Earth has plenty of natural resources if we just learn how to develop them. (6)	❍	❍	❍	❍	❍
Plants and animals have as much right as humans to exist. (7)	❍	❍	❍	❍	❍
The balance of nature is strong enough to cope with the impacts of modern industrial nations. (8)	❍	❍	❍	❍	❍
Despite our special abilities, humans are still subject to the laws of nature. (9)	❍	❍	❍	❍	❍
The so-called “ecological crisis” facing humankind has been greatly exaggerated. (10)	❍	❍	❍	❍	❍
The Earth is like a spaceship with very limited room and resources. (11)	❍	❍	❍	❍	❍
Humans were meant to rule over the rest of nature. (12)	❍	❍	❍	❍	❍
The balance of nature is very delicate and easily upset. (13)	❍	❍	❍	❍	❍
Humans will eventually learn enough about how nature works to be able to control it. (14)	❍	❍	❍	❍	❍
If things continue on their present course, we will soon experience a major ecological catastrophe. (15)	❍	❍	❍	❍	❍

Q52 To what degree do you associate with the following statements about energy conservation?

	Strongly Agree (1)	Agree (2)	Unsure (3)	Disagree (4)	Strongly Disagree (5)
My opinion on energy conservation seems not to count with other people. (1)	❍	❍	❍	❍	❍
When they want to understand energy conservation, other people do not turn to me for advice. (2)	❍	❍	❍	❍	❍
People know that I engage in energy conservation behaviors based on what I have told them. (3)	❍	❍	❍	❍	❍
I often persuade others to engage in energy conservation behaviors. (4)	❍	❍	❍	❍	❍
I often influence people’s opinions about energy conservation behaviors. (5)	❍	❍	❍	❍	❍

Q53 To what degree do you associate with the following statements about sustainable behavior? Note: Examples of sustainable behavior include, but are not limited to, recycling, energy conservation, composting, water conservation, and responsible purchasing.

	Strongly Agree (1)	Agree (2)	Unsure (3)	Disagree (4)	Strongly Disagree (5)
My opinion on sustainable behaviors seems not to count with other people. (1)	❍	❍	❍	❍	❍
When they want to understand sustainable behaviors, other people do not turn to me for advice. (2)	❍	❍	❍	❍	❍
People know that I engage in sustainable behaviors based on what I have told them. (3)	❍	❍	❍	❍	❍
I often persuade others to engage in sustainable behaviors. (4)	❍	❍	❍	❍	❍
I often influence people's opinions about sustainable behaviors. (5)	❍	❍	❍	❍	❍

Q54 If you have any comments or thoughts you would like to add for the researcher, please use the space provided:

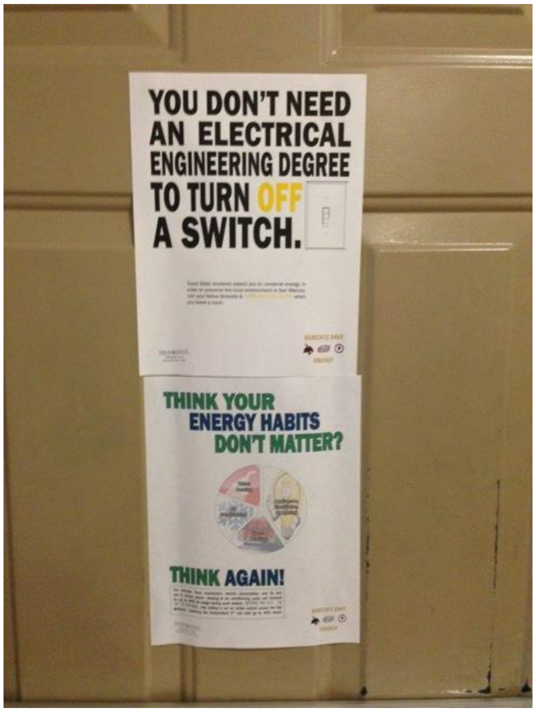
Q55 Thank you for completing the survey.

If you would like to be entered into a raffle for a chance to win one of two prizes, you may enter your email address below. Your email will not be associated with any survey responses.

Prizes: 2 Amazon FireTV Sticks

Email:

APPENDIX I – Photos of Outreach Materials



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