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The effects of the go for the green challenge on electricity use, behaviors, and attitudes of Western Washington University residents.

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THE EFFECTS OF THE GO FOR THE GREEN CHALLENGE ON ELECTRICITY USE, BEHAVIORS, AND ATTITUDES OF WESTERN WASHINGTON UNIVERSITY RESIDENTS

By

Kimbrough Leverton Mauney

Accepted in Partial Completion

of the Requirements for the Degree

Master of Education

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A Thesis
Presented to
The Faculty of
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ABSTRACT

This thesis investigates the effect of the Go for the Green Challenge (GGC), a multi-faceted, educational awareness and behavior change campaign originating in the Office of Sustainability, on residents of Western Washington University. Per capita residence hall electricity use figures in participating and control halls were evaluated. Surveys of residents gauged energy use behaviors, and a questionnaire assessed how hall leaders implemented GGC. Participating halls had significantly less electricity use than control halls. Correlation was significant between electricity reductions and certain components of GGC. The halls most affected by GGC had designs conducive to social diffusion and leaders that mobilized efforts to reduce electricity use and increase resident participation and awareness.

ACKNOWLEDGEMENTS

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Seth Vidana, coordinator of WWU's Office of Sustainability, Willy Hart, director of University Residences (UR), and John Purdie, associate director for Residence Life, deserve many thanks for allowing this study to happen within the framework of the Residents' Resource Awareness Program and its Go for the Green Energy Challenge. Help and support from Leslie Strong, Karen Walker, Karen Neely, Bob Carr, Sheryl Jensen, Carrie Danielson, Judith White, Phil Burns, Lafayette Baker, Allison Bennett, and Lindsay Jarratt, all RL staff, was crucial to this thesis. The UR staff are making efforts to bring sustainability issues to the forefront of conversations and actions within their work, from purchasing, to dining, to residential programming. This trend is one that could be followed by other WWU departments and institutions elsewhere.

Support and love from my dad and mom has carried me through my academic career and will no doubt lead me forward my entire life. They are my dearest friends.

Thanks to Jordan Sly, Environmental Science Master's candidate and my statistics advisor. Nancy Bonnickson, of Huxley College, deserves many thanks for sustaining my health as I studied at WWU, with food and gardening.

"Our way-of-life is rife with opportunities to conserve energy."

–Denis Hayes in Worldwatch Paper 4, Energy: the case for conservation, 1976

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LIST OF ABBREVIATIONS

AASHE- Advancement of Sustainability in Higher Education
ASE- Alliance to Save Energy
ASRC- Associated Students Recycle Center
BT-Buchanan Towers
BW- Birnam Wood Apartments
CBSM- Community Based Social Marketing
E- Edens Hall
EN- Edens North Hall
ERs- EcoReps
F- Fairhaven Hall
FM- Facilities Management at WWU
GGC- Go for the Green Energy Challenge
H- Higginson Hall
HC- Hall Councils
K- Kappa Hall
kWh- kilowatt hour
LEED- Leadership in Energy and Environmental Design
M- Mathes Hall
NWF- National Wildlife Federation
OS- Office of Sustainability at Western Washington University
PSE- Puget Sound Energy
RAs- Resident advisors
RDs- Resident directors
ResRAP- Residents' Resource Awareness Program
SRE- Students for Renewable Energy
UR- University Residences
WWU- Western Washington University

CHAPTER ONE

INTRODUCTION

This thesis investigates the effect of the Go for the Green Challenge (GGC) on electricity use, energy use behaviors and attitudes of residents at Western Washington University (WWU), located in Bellingham, Washington. Of 12,550 undergraduate students, 3,996 live in 16 residence halls on campus. A pilot position, funded by the University Residences (UR) department, coordinated GGC to educate campus residents and achieve reductions in resource use. The position was housed in the Office of Sustainability (OS) for the 2007-2008 school year[1].

Research Questions

The goal of this study was to determine if a multifaceted campaign targeting electricity use is an effective way to decrease electrical consumption and influence residents' behaviors concerning use. The study aimed to answer three questions and test three hypotheses:

Q1. Did GGC have the effect of decreasing electricity consumption?

Q2. What explains differences in results between halls?

Q3. Did GGC have an effect on electricity use behaviors?

H_{01}. The change of electricity consumption from the average of the three previous years to 2008 will not differ between treatment halls and non-treatment halls.

H_{02}.Certain aspects of GGC, specifically the design of the treated halls, and the number of residents who pledge, complete voluntary surveys, classify hall mates as efficient users, and report learning will not correlate with electricity use.

H_{03}. Certain aspects of GGC, specifically the number of residents who pledge, complete voluntary surveys, classify hall mates as efficient users, and report learning will not correlate with each other.

Facilities Management (FM) at WWU provided electricity consumption data from building-level meters. Residents were surveyed at the beginning, middle, and end of GGC concerning their behaviors and

[1] In May 2008, funding was granted for continuation of this position.

attitudes. Leaders in the halls, specifically resident directors (RDs), resident advisors (RAs), and EcoReps (ERs) were questioned about program implementation and their own behaviors.

Significance of Research

In the field of environmental education, researchers and practitioners help people build conclusions about living in harmony with and understanding our effects on the natural environment. One of the foremost educators for the environment, David Orr, hopes educators develop mindsets and habits that will allow humans to live sustainably on earth (Orr, 1992). Orr (2004) expects institutions of higher education to be energized by an awareness of connections and full promise of creating a sustainable future. The activists and educators behind GGC aimed to tap into those characteristics present in the WWU culture, advancing sustainable daily practices.

This study benefits certain university groups. Answering the first question will give facility managers insight as to whether participatory interventions can affect electricity use. UR will benefit from the documentation of residents' and leaders' actions. By identifying effective program components this study serves as a blueprint for future campaigns based in the OS. Leaders of other organizations trying to effect change will benefit from lessons learned.

Few studies of behavioral change interventions deal with campus residential populations. Lehman and Geller (2004) signaled the need for documentation of such interventions in finding that since the late 1970s, studies on behavioral interventions have been outnumbered at a rate of seven to one by those on people's attitudes and traits. This thesis, which focuses on aspects of GGC that successfully changed behavior and influenced electricity reductions, will add needed research to the field.

Finally, documentation of a resource reduction campaign is beneficial to the provider of the resource, in this case Puget Sound Energy (PSE). PSE[2], which promotes and educates customers about efficient energy use, can use this study as an example for other large customers to follow.

Study Overview

Chapter Two, "Overview of Relevant Literature," presents theories of human behavior change that were useful to this study. Chapter Three, "Collegiate Greening & Energy Reduction Campaigns," highlights the

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[2] The electricity supply profile given by PSE is as follows: hydro 45%, coal 34%, natural gas 17%, wind 2%, nuclear 1%, biomass/waste/landfill gas/petroleum 1%. This mix of supply sources yields an emission of 1.04 pounds of carbon dioxide for every kilowatt hour generated (Ted Brown, personal communication, 05/17/07).

current broad context for energy conservation and some campaigns that served as guidance to program conception at WWU. Chapter Four locates the reader in the context specific to WWU and explains creation of GGC.

Methods, data analysis, and associated limitations are discussed in Chapter Five, followed in Chapter Six with an explanation of results. Chapter Seven discusses results, conclusions, and opportunities for stakeholders, educators, and campus activists for future programs and studies.

CHAPTER TWO

OVERVIEW OF RELEVANT LITERATURE

The amount of literature in the last thirty-five years regarding energy use is staggering. Much work describing why and how Americans should reduce energy consumption followed the oil crisis of the 1970's. Studies since then have broadened to incorporate applied behavior analysis, humans' effect on the environment, education for the environment, psychology, and relationships between attitudes, values, and energy use behaviors. By reviewing relevant theories and case studies, this chapter highlights the theoretical reasoning behind the creation and methodology of GGC.

The section begins with a glance at two theories relevant to methodology of energy reduction campaigns: social diffusion and small community management, also referred to as community based social marketing. Then a popular model for behavior change is discussed. To successfully employ this model, change agents must be aware of the human element, i.e. the audience being targeted with interventions. This involves understanding, at least partially, how people tend to respond to certain types of interventions.

Social Diffusion and Small Group Community Management

Social diffusion refers to the process of leading an audience to (1) consider their behaviors, (2) see successes of their efforts, and then (3) tell others of the benefits and what was necessary to do to realize those benefits (Geller, 1992). Using video footage to show desired actions is a proven way to begin the social diffusion process (Gardner & Stern, 1996), especially in the present society that delights in watching television. One way to do show success is to provide feedback on how actions benefit the greater society (Nickerson, 1999). Nickerson (1992) claimed that people ought to know the exact effects of their behaviors on the environment. This is relevant to campus residents, whose individual actions combine to have a larger effect as the entire residential community. Through social diffusion, as residents are made to feel part of a cooperative effort, more participation will occur (Geller et al., 1982).

Gardner and Stern (1996) considered what methods work best to foster the social diffusion process as they addressed four types of approaches to encourage behavior for the common good: government laws, education programs, small group or community management, and moral, religious, or ethical appeals. While each method is capable of providing solutions, each has limitations. Enforcing and designing laws so as not to interfere with human rights is difficult. Efforts to educate may be ignored if sources are not credible, if language is not familiar, or if personal biases exist against the educator. Appealing successfully to values or beliefs requires an acute understanding of their origins, which differ for everyone. The community management approach, relying on informal development and enforcement of behavioral rules, works best if most members have a sense of altruism, caring more about benefits to the group than those to themselves personally (Gardner & Stern, 1996).

Recently a Canadian psychologist, Doug MacKenzie-Mohr, has led the field of non-governmental organizations, agency directors, environmentalists and others to use social diffusion in their specific communities to achieve behavior change. Perhaps to appear more desirable to sectors of society unaccustomed to demanding behavior change for the common environmental good, MacKenzie-Mohr and Smith (1999) renamed the process community based social marketing (CBSM). The strategy involves marketing a particular behavior similarly to how a product is marketed. CBSM strategies, incorporating psychological aspects that will be reviewed below, include using commitments and social norms, providing feedback and incentives, and understanding barriers to change. A look at the research submitted to the CBSM Web site reveals that successful interventions carefully matched a specific marketing tool with a precise target behavior for a particular audience (MacKenzie-Mohr & Smith, 1999). The fact that CBSM methods are being used widely in Canada, all over the United States, in Australia, England, and Africa, suggests that the approach can be tailored to fit extremely different populations of people. CBSM is a methodology that divides the complex goal of behavior change into manageable pieces. The popular behavior change model discussed next is a tool, enabling change agents to realize success, which underlies many parts of CBSM.

Antecedent-Behavior-Consequence Model

Behavior change interventions should recognize the events that direct and the consequences that motivate behaviors (Geller, 2002, 1989). Antecedent strategies, designed to increase the likelihood of target behaviors, include modeling, prompting, and asking for commitment; rewards and feedback are presented as consequences of behaviors. To clear the way for behavior change Geller et al. (1982) suggest removing possibilities for wasteful behaviors and establishing antecedent motivations and positive consequences for the targeted behavior. Geller (2002) emphasized that rewarding for desired behaviors should be done carefully. When interventions are brief, targeted audiences may realize rewards, soon abandoning any changed behaviors. To ensure that changes endure, rewards should be offered over extended periods of time, or given out only if a certain level of behavior, such as a 10% electricity reduction from baseline use, is reached.

The three step model and both social diffusion and CBSM theories were developed out of a desire for change and with careful consideration of the psychology behind human behavior. Implementation of interventions using these tools is aided by considering how the certain target audience might react.

Psychology: Influencing Human Behavior

The human dimensions of energy use are a rich mixture of cultural practices, social interactions, and human feelings that influence behavior (Stern & Aronson, 1984). Based on careful large-scale empirical work Stern & Aronson (1984) provided a thorough dissection of how people *use* energy within the various contexts of how people *think* about it. Those trying to affect energy use must be aware of the different types of energy user, based on opinions and values held: investor, consumer, member of a social group, problem avoider, and expresser of personal values (ibid). Ideally, those who openly express personal values can be activated to model their behaviors, influencing behaviors of other types of users in desired directions.

No matter how motivated the activists, some aspects of human psychology prevent change. Providing feedback of measurable progress, models of target behaviors, and chances to commit publicly to certain actions helps reduce psychological and social barriers. Educating with information from credible sources (Stern & Aronson, 1984) helps remove internal barriers like lack of knowledge or misinformation (Gardner & Stern, 1996). However, even the most successful education strategy may not result in lasting behavior change (Geller, 1992); if marketing tools do not perfectly match the situation, the message may be ignored (MacKenzie-Mohr, 1999). Since some people may be more inclined to change a certain behavior just one time while others prefer to regularly make small changes, change agents must also consider the distinction among behavior changes that are one-time events, such as installing low-flow shower heads or buying a fuel-efficient car, and those that require repetition, such as putting on an extra sweater every day or turning off lights. The small, easy-to-complete, repetitive changes do have important effects at achieving desired goals of conservation programs (Geller, 1982).

The task of motivating audiences is further hindered by barriers out of individual control, such as structural inefficiencies or low financial costs associated with some resources. Part of a recent review on the role of psychological research in addressing human-induced environmental change elaborates on the importance of intrinsic motivation (Nickerson, 2003). People who change energy use patterns may not feel positive environmental effects right away. So while appropriate feedback is helpful, the effective behaviors must be valued for their own sake (Nickerson, 2003). This organization of values may necessitate a more fundamental change:

> The most significant need for the future is for a willingness to adopt a more reflective attitude toward the world and our places in it than we have tended to take in the past…We must be more prepared to examine our deepest beliefs and live by those we find compelling.... We must learn to think for ourselves and to work for goals that reflection has convinced us are worthwhile... (p.371-372).

What humans can or will do to reduce their detrimental effects is sometimes debated rather than experimented with. The broad public may hold beliefs and perform behavior patterns so strongly that consciously executed behavior change campaigns are ineffective. However an intervention, such as the one studied here, targeting a young population situated among intellectuals and innovators, has much reason to remain hopeful for change.

CHAPTER THREE

COLLEGIATE GREENING & ENERGY REDUCTION CAMPAIGNS

Reception of any type of innovation depends on the context. This chapter positions the reader in the environmentally conscious atmosphere of the contemporary collegiate community. Energy use, involving many aspects and all members of society, is an issue that receives much attention. Large-scale interventions are one way to bring attention to energy use. Other actions taken by universities form the context for conservation and behavioral change campaigns.

Outreach to Campuses

As mentioned in Chapter 1, educators for the environment expect institutions of higher learning to be examples of how to exist in harmony with our earth. Realizing this, large environmental non-profit organizations devote many efforts to working with colleges and universities. The National Wildlife Federation (NWF) began a Campus Ecology Program in 1989 (NWF, 2008). NWF helps campus organizations carry out projects, encourages collaboration with communities, and supplies resources to leaders. The United Nations naming the first decade of the new millennium as the Decade for Education for Sustainable Development paved the way for increasing numbers of national organizations devoted to sustainability and related practices.

The Alliance to Save Energy (ASE) is another organization to which institutions turn for support, resources and information dissemination. For example, California universities work with ASE to set up green rooms for incoming students to tour, displaying hemp towels, reusable shopping baskets, and organic cotton sheets with their price tag and store of purchase (ASE, 2007).

As campuses all over America respond to the challenge of becoming leaders in sustainability efforts, they collaborate through the Association for the Advancement of Sustainability in Higher Education (AASHE), formed in 2006. The ASSHE Web site is an extensive resource for university activists and was particularly useful to this thesis by linking to peer-to-peer sustainability and dorm energy reduction programs of member institutions (AASHE, 2008). Other organizations devoted to sustainability on campuses include and are not limited to the Association of University Leaders for a Sustainable Future and the Alliance for Sustainability through Higher Education[3].

Work to Green Campuses

Across the United States, 521 university heads have signed the American College & University Presidents Climate Commitment (PCC, 2008). This initiative addresses climate change by garnering institutional commitments to neutralize greenhouse gas emissions and increase research and education needed to stabilize the earth's climate (ibid). By doing this, they commit their institution to increasing education about climate change that results in real life projects to reduce carbon emissions. Thus, students, faculty, and staff are employing research, course work, curriculum, innovations and activism to make changes on their campuses.

Building monitoring

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[3] A thorough listing of such organizations can be found on the website for a WWU environmental studies class entitled Campus Planning Studio, http://www.ac.wwu.edu/%7Esustwwu/resources/links.html .

Students at Oberlin College in Ohio created a resource monitoring tool for the dorms. The system provides detailed, real time feedback on water and electricity use (Lucid Design Group, LLC, 2007) and is now employed by 25 other institutions (Michael Murray, personal communication, April 20, 2008). At WWU, two electronics-engineering seniors designed a system that could monitor electricity use on a particular floor of a campus academic building. The system was not readily deployable in other buildings due to the cost. The OS is working with SRE and other students to begin monitoring electricity in the student recreation center.

Wind power

A wind turbine at Carleton College, in Minnesota, produces about 900 kilowatts (kWh) an hour on average, more than the college had hoped for and enough electricity to meet almost half their need (Carlson 2004). At WWU, the Students for Renewable Energy (SRE) club is beginning to investigate the possibility of harnessing wind on campus.

Green building

As one example of the many institutions seeking the United States Green Building Council's Leadership in Energy and Environmental Design (LEED) certification, the University of South Carolina constructed a 500-student residential complex of four three-story buildings and, according to the *Chronicle of Higher Education*, claims it is the largest green dorm in the world (Carlson, 2004). At WWU, the Wade King Recreation Center was awarded a LEED certification, as is planned for the Academic and Technology Services building still under construction.

Solar power

Engineering undergraduates at Seattle University developed a solar panel system that collects enough sunlight to power an energy-efficient home for one year (Frey, 2006). At WWU, SRE members successfully lobbied and coordinated plans for installation of solar panels on the campus union building.

Curriculum for environmental responsibility

Washington State University offers an undergraduate degree in organic farming (Frey, 2006). The University of Washington has a Center for Urban Horticulture (ibid). WWU houses the Vehicle Research Institute, where students experiment with renewable fuel sources and automobile design, and the Huxley College of the Environment, which offers a minor in sustainable design and concentrations in environmental science, policy and education. Currently a committee at WWU is investigating ways to advance sustainability education on campus[4]. The University of New Hampshire (UNH), with the oldest endowed sustainability program in higher education in the nation, a minor in sustainable living and a graduate program in sustainable engineering (UNH Office of Sustainability, 2008), serves as an example to other universities striving to practice and educate about sustainable practices.

Composting

Composting takes different forms at many colleges in Washington. Seattle University uses its compost on its grounds (Frey, 2006) and the University of Washington positioned bins in eateries so students and faculty can compost their own food waste (Kelley, 2007). Sanitary Services Company's successful food waste-to-compost program has teamed with WWU's Dining Services, helping turn thousands of pounds of waste into usable soil[5]. The Cornell Waste Management Institute (CWMI), part of Cornell University, offers extensive information and resources via their Web site and accomplishments (CWMI, 2007).

Energy Reduction Campaigns

Energy reduction campaigns are led by utility companies, non-profits, federal and state governments, and academic institutions (Centre for Sustainable Energy, n.d.; Duke Environmental Alliance, n.d.; Edison Electric Institute, 2008; Governor's Natural Resources Office, 2007; Minnesota Departments of Administration and Commerce, n.d.; Sustainability Victoria, 2007; United States Department of Agriculture, n.d.). Many universities and colleges have run energy challenges (Table 1). While significant results have been realized, they are not documented here since dollars saved and carbon dioxide kept out of the atmosphere, data generally reported, depend on the electricity supply profile of the regional utilities. The initiators of the programs vary from student groups to facilities management departments.

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[4] For more information on WWU's Sustainability Committee and subcommittees, contact the Office of Sustainability.
[5] At present this partnership is inadequately advertised to students. The Office of Sustainability at WWU is working with a few campus groups to make composting more visible and accessible to all campus users.

Table 1.
Examples of Collegiate Energy Reduction Programs With Titles, Target Audiences, Time Periods, and Methods.

Institution, Location & Intervention Title	Target audience	Length, year	Intervention methods
University of Colorado, Boulder	1,000-2,000 residents	10 & 6 weeks, 1977	Prompts, information, feedback, meetings
Daemen College, NY	2,000 residents	6 months, 2006	Energy-savings brochure, stickers & posters, emails on how to save energy with computer use
Washington Coll., MD Do it in the Dark George Goes Green	1,350 residents	3 weeks, 2006	Green pledge online, signers listed publicly, competitions
Duke University, NC Eco-Olympics	1,700 residents	1 month, yearly since	Point system for competition, prize incentives, surveys, film showings, Eco-Trivia night
Tufts University, MA Where is your hot spot?	Upperclass suite-style dorms (2)	8 weeks	Competition for prizes
Harvard University, MA Resource Efficiency Program (REP)	6,000	Eco-Olympics 1992, Green Cup since ’03-04	Information sharing, suggestions to administrators for barrier removal, EcoProject competition.
Univ. of Connecticut Eco-Madness	2,200 residents	1 month	Purchased carbon offsets equal to winners’ savings, presented certificate to Eco-Captains.
University of Toronto, Canada Pilot Program	1 hall	School year 2005-06	Personal pledges, word-of-mouth encouragement, visual prompts
University of Bath, United Kingdom	2,000 residents	6 months	Tips on web, handouts, emails, competition updates, graphs showing weekly consumptions

GGC implementation incorporated aspects that worked well elsewhere, and at the same time tailored to the specific populations living in WWU residence halls. GGC happened at an opportune time, when national consciousness of environmental issues was high, at least at the collegiate level, and the WWU Office of Sustainability existed to support the campaign.

CHAPTER FOUR

CONTEXT & CREATION OF GO FOR THE GREEN CHALLENGE

This chapter explains why and how the research question was formed, beginning with the motivation behind reaching out to residents, a population of impressionable minds that many campus groups strive to target. Discussion of the context of conservation that surrounds WWU residence halls and characteristics unique to them completes the chapter.

Motivation for Research

In June of 2007, residents were surveyed informally. An incentive was offered to decrease self-selection bias[6]. Trends in answers provided insight for planning an energy reduction campaign. The responses implied that a consciousness existed among residents that would be favorable to such a campaign. For example, four of every five residents agreed that an individual's actions have an effect on overall hall energy consumption, and about two thirds were very (8%), fairly (24%), or maybe (35%) willing to change the behavior they listed as hardest to change[7]. Many (65%) were interested in metering their appliances. Just under half reported interest in attending a workshop and being active in a program to reduce personal consumption. To gauge opinions about use, respondents were asked to divide 100 theoretical residents into 4 categories, super conservers, efficient users, oblivious users, and over consumptive users. Averages for percent of residents falling into the 4 categories were 10%, 26%, 41%, 23%, respectively. The fact that only 30% of the respondents knew what resource provided their building's heat supported the common belief that many residents were oblivious to how they used electricity. As money and materials were not in place to set up Watt Watchers[8] in every dorm room, providing workshops and programs seemed the most feasible and desirable options.

EcoReps

The EcoReps (ERs) were first recruited in residence halls in 1994 to be the student-educator arms of the Associated Students Recycle Center (ASRC). They worked with the ASRC Educator to conduct the first Eco-Olympics, targeting recycling, in 1993. The next large educational intervention in the resident halls occurred about five years later, when the ASRC held an Eco-Triathlon that again targeted recycling in residence halls (Richard Neyer, personal communication, June 2007). Inaccurate data, inconclusive results and no way of informing audiences of their standings in the competitions probably made for ineffectiveness. Little to no assessment or evaluation exists about past programs, and hall-wide campaigns have dwindled at WWU since 2000 (ibid). The structure and scope of the ERs and residence hall programs needed to be changed. More help was needed for implementation of successful interventions.

Residents' Resource Awareness Program (ResRAP)

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[6] Informal surveying occurred over 3 days. As residents left the north campus dining hall, they could read small signs on the wall that said for 5 minutes of their time they could be entered into a raffle for free movie tickets. Of about 700 residents who passed by, 37 voluntarily completed the survey.

[7] Use of lights and hot water for laundry were the behaviors reported as easiest to change. Showering everyday was difficult to change. Majorities were willing to unplug their computer at night and do laundry half as much.

[8] These are devices that record and show the electricity used by the appliance plugged into them.

The coordinator for the Office of Sustainability[9] (OS) unknowingly rescued the situation by requesting that a position be created within the OS for residential outreach. The present author developed a description, titling it Coordinator for the Residents' Resource Awareness Program (ResRAP). UR funded this as a part-time, pilot position for the school year, and the present author began work as ResRAP coordinator in September 2007.

Collaboration with Residence Life

The 12 resident directors (RDs) were informed of ResRAP and the benefits and goals of an energy reduction campaign in September 2007. At the information fair during the second week of resident advisor training, ten RAs discussed ideas with the coordinator and learned about ResRAP.

Repositioning & Recruitment of EcoReps

The ASRC agreed to turn the EcoRep program over to ResRAP. The ResRAP coordinator began recruitment of ERs by holding a workshop on environmental stewardship during new student orientation and continued recruiting by attending hall council (HCs) meetings. HCs are leadership and decision-making bodies of residence halls. Not all HCs had a description of the ER position. Thus, ERs had previously not been elected in every hall, and RAs were unaccustomed to promoting the position. By mid-November, nine ERs representing five residence halls were meeting with the ResRAP coordinator. They decided to name the energy challenge "Go for the Green."

Why Target Electricity?

The operations manager for WWU's Facilities Management (FM) division, Ron Bailey, was contacted in May 2007 to determine if measuring energy use of residence halls was feasible. Bailey is the primary and most familiar user of data from the electric and natural gas meters. FM tracks electricity, natural gas (used for heating) and water usage. Electrical data were determined to be the most specific to individual halls, enabling fair comparisons, and the most feasible for providing clear feedback (Table 2).

[9] The OS was formed as a result of student work, the university president signing the Presidents' Climate Commitment (PCC, 2008), and the WWU Sustainability Committee.

Table 2.
Campus Resources and Notes on Possibilities for Study

Water	Most residence halls do not have separate water meters.
Gasoline (private automobiles)	Use relies solely on self-reporting, making comparisons between halls difficult for competition purposes. No data collection system in place.
Food	Composting system is not advanced enough for monitoring. Impossible to track waste to residents of specific halls.
Waste	No system in place to monitor weight of trash in dumpsters.
Recycling	Limited staff and equipment restricts ASRC to target only one, or vaguely target all campus buildings for measuring recycling efforts. Feedback and accurate data are lacking.
Direct Energy-electricity	Metering system in place for each separate building. Use recorded monthly by FM staff over long time periods. Success proven at other universities (see Table 1).
Direct Energy- natural gas	Halls share natural gas meters. Mean outside temperature, an uncontrolled variable from year to year, influences use.

Contexts Affecting WWU Residents' Energy Conservation & Awareness

For this study it was assumed that residents would be aware of some issues related to energy use, due to national news and printed articles in campus sources. During the 2007-2008 school year, WWU publications (*The Western Front*, *The Planet*, *AS Review)* often had articles about energy use, alternative transportation, student work on hybrid vehicles, and eco-initiatives such as car sharing and stream restoration by Bellingham groups. *The Western Front* and the *AS Review* printed articles in the fall quarter about ResRAP, mentioning the upcoming challenge. The *AS Review* featured a quarter-page "Green tips of the month" suggested by the Associated Students' Environmental Center. Some residents may have seen on television a popular Walt Disney character urging them to use energy efficient light bulbs, a result of the Department of Energy teaming with the famous animators. The documentary entitled "An Inconvenient Truth," by Al Gore had also recently received wide publicity.

Issues Unique to WWU Resident Halls

Campus residence halls are ideal locations for educational and personal development (Schroeder, Mable, & Associates, 1994). A sense of community is encouraged and readily attainable, depending in part on building design. Living in close contact lets residents interact more and internalize changes they see being made by leaders, for example. These qualities make campus residences prime locations for studying the effects of interventions on attitude and behavior. If planners and leaders of non-collegiate residential communities are aware of successes in university settings, they can consider what aspects of their communities could be altered to create an environment conducive to behavioral interventions.

Campus residential research poses some difficulties, perhaps partly explaining the small amount of published studies on their populations. One problem is low participation rates, both in surveys and events. Recently UR sent an online survey to all residents. The response rate of 38% of the resident population was a higher response rate than usual (John Purdie, personal communication, September, 2007). Of those, 15% participated most of the time or always in dorm activities and 80% did not participate at all. This highlights another problem: halls are the places where residents relax. While many may appreciate the educational opportunity of living on campus, many others may not be interested in actively learning by reading bulletin boards or going to programs.

Finally, no two residence halls at WWU have the exact same layout or square footage; this results in uneven building efficiencies. For this reason, campaign implementation must be tailored to each specific dorm population. This is discussed in detail in the methods section.

CHAPTER FIVE

METHODS

This Chapter explains the design of the thesis study, GGC intervention and implementation, and the methods for data analysis and evaluation. Some limitations on data collection and analysis were unavoidable due to the nature of a behavior change experiment in an uncontrolled environment. These limitations and their effects on reliability and validity of the data collected are discussed when appropriate.

Study Design

This study considered the first year of GGC. Eight residence halls served as the treatment group: Birnam Wood (BW), Buchanan Towers (BT), Edens (E), Edens North (EN), Fairhaven (F), Higginson (H), Kappa (K), and Mathes (M). Eight remaining residence halls, Beta, Gamma, Sigma, Highland, Alpha, Delta, Omega, and Nash, were not targeted with the program and served as the non-treatment group. Data from electric meters were used to test the null hypothesis H_{01} that the change of electricity consumption from the average of the three previous years to 2008 would not differ between treatment halls and non-treatment halls. Treatment was not assigned randomly to halls, since only the halls with ERs or involved RDs were involved with GGC. The electricity study design was thus quasi-experimental, using a nonequivalent groups design. The treatment and non-treatment halls were considered two similar groups, where prior differences were not accounted for in assigning treatment.

To answer the second thesis question of what explains the differences among halls, qualitative data about implementation was collected via a written questionnaire to leaders (Appendix A), undocumented conversations and casual observations in the halls. Pre- and post-survey behavioral data were analyzed to determine effects of GGC on behavior and attitudes (Appendix B).

Survey data were used to create variables to test the null hypotheses dealing with relationships between electricity use and specific aspects of GGC (H_{02} and H_{03}). Surveys collected baseline and post-challenge electricity use behaviors. Surveys were given only to the treatment hall populations, and response was voluntary. Because of this, and lack of communication with non-respondents, responses may be considered biased. Threats to external validity of survey data are high; generalizing to residents other than those who responded to the surveys is limited because of self-selected non-representative sampling. Reporting behavior change is limited, because samples responding to the three surveys were assumed to be independent; no attempt was made to match pre- and post- responses. Further, since the pre-survey was open for response as GGC began, respondents may have been influenced towards reporting more conserving behavior than was true. Therefore changes in behavior reported in this study are only estimations, but they may be underestimations.

Intervention (Treatment)

The Go for the Green Challenge (GGC) was an energy reduction program of the Office of Sustainability (OS) that encouraged campus residents to decrease use of and learn about resources. The GGC began at the start of the winter quarter, January 8th, 2008, and continued until the beginning of the spring quarter, April 1st, 2008. Planning began in November 2007. Nine EcoReps and 5 RDs representing 8 different residence halls agreed to participate in the energy challenge over the winter quarter. The goals of GGC were a 10% reduction in electricity use and increased awareness and participation among residents. Two RDs and the ResRAP coordinator established a point system so halls could be challenged on 2 levels: resident participation and reductions in electric meter readings. For each percent reduction, halls received 20 points. Every time a resident pledged[10], completed online surveys, or attended hall eco-events, one point would be added to their hall's total points. The ResRAP coordinator would provide consumption figures and background information for the RAs, send electronic surveys to residents at the beginning, middle and end of GCC, help facilitate eco-events, provide feedback on a Web site -including money and carbon dioxide emissions saved-, and track hall

[10] The Green Pledge stated, "I pledge to reduce my energy use in the hall," and listed 5 ways to reduce: unplug electronics, shut your window, turn off lights, limit shower time, and shut off your power cords.

standings in the challenge. Hall leaders would encourage residents to pledge, create informative bulletin boards, talk about ways to reduce electricity with residents, and plan and promote two eco-events during the quarter.

To encourage participation and accomplishment of the reduction goal, prizes were offered to the halls with the most points. In some cases, hall events publicized a raffle of a small prize. Considering that an award system can be difficult to sustain over long time periods (Geller, 2002), prizes were donated by local businesses that support efficient use of energy and resources (Appendix C). For example, the Outdoor Center at WWU offered free trips and a high ropes challenge course offered a free day on the course. Another incentive discussed among involved RDs was that money saved on electricity would be redirected into their hall budgets. This is still under discussion with administration.

Implementation

Treatment was not identical for each hall, i.e., implementation of GGC varied, because leaders were encouraged to take initiative. A questionnaire for hall leaders was designed to help determine differences in implementation (Appendix A). The researcher, through observation in halls and casual discussion with hall leaders, discovered other differences in implementation. These differences largely explain the variations in electricity reductions among halls and are discussed in Chapter 7.

Electricity Meter Readings

Each hall has its own electricity meter. On February 1st, March 3rd, and April 1st, electric meters[11] were read by FM staff and recorded into spreadsheets that were made available on the WWU electronic network. Since the kilowatt hours (kWh) consumed by a resident in any hall depends on how efficient the building itself is, the most valid comparison is percent change in per capita use. The units for direct electricity use data used in this study were therefore kWh per resident and percent change (Appendix D). To calculate per capita use, total kWh for each building were divided by the building's winter quarter population[12] of residents. For each month, these data were compiled for 2008 and for the preceding three years (2005, 2006, 2007). The preceding years'

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[11] The meter for Birnam Wood is normally read on a different schedule. To have data for BW that corresponded exactly with the other time periods, FM provided data supplied directly from PSE.

[12] Fourth week population figures were used in order to be far enough into the quarter to allow for withdrawal and room switching (Karen Walker, personal communication, June 2007).

figures were averaged to create a baseline[13]. This study used a percent change to compare how each residence hall's monthly (January, February, and March) per capita use changed from the baseline to 2008.

Because interaction between residents in treatment and non-treatment halls could not be controlled, threats of social interaction and selection (Trochim, 2006) must be considered along with electricity use results. Individuals in non-treatment halls were free to imitate those in treated halls and factors other than the treatment may have led to differences between groups. Various characteristics of the halls influence electricity use and could not be controlled in this thesis design (Table 3). Testing for a relationship between design and electricity use was done to verify if design influenced electrical consumption.

Table 3.
Design Aspects of Treatment Residence Halls

Hall[a]	2008 winter pop.	Leader: Resident ratio[b]	Notes on structure	Building Design Type[c]
K	217	1: 31	No elevators. Common hall bathrooms. 4 floors. One computer in lab. Laundry room.	4
E	148	1: 37	First floor elevator serves 3 upper floors of residences. Electricity readings include administrative offices on ground floor. Suites share private bathroom.	3
EN	99	1: 52	Elevator. A walkway connects E to EN on the second floors. Laundry room used also by E residents.	4
H	219	1: 37	Elevator serves 5 of 5 habited floors. Suites share private bathroom. Computer lab serves E & EN. Laundry room. Renovations in 2006 increased efficiency of heat pumps.	2
M	294	1: 29	Elevator serves 8 floors: top 7 habited, laundry in basement. Common hall bathrooms. 7 computers in lab.	4
BT	392	1: 44	Elevator serves 8 habited floors. Suites rooms share kitchenette and bathroom. 2 computers in lounge.	3
BW	511	1: 86	No elevators. 6 separate identical 2-story apartment complexes, each w/ 20 units, shared by 4 residents. Full kitchens use natural gas; community is exempted from on-campus dining plan. Two laundry facilities.	1
F	609	1: 38	No elevators. 12 separate, 4-story identical stacks w/ suites of 4 to 10 residents sharing a bathroom. Laundry in each stack. Lighting efficiency upgrades began in 2006.	3

a. K-Kappa, E-Edens, EN-Edens North, H-Higgingson, M-Mathes, BT-Buchanan Towers, BW-Birnam Wood, F-Fairhaven.
b. Leader ratio: This shows how many residents each leader of GGC would be responsible for with equal distribution; the leaders included ERs, RDs, and RAs.
c. 1-apartments/exterior hallways, 2-suites/exterior hallways, 3-suites/interior hallways, 4-corridors of double rooms/interior hallways, as termed by UR.

Surveys to Residents

[13] This technique worked successfully at the University of California, Santa Barbara, and Harvard University.

The online survey tool supplied by WWU's Residential Technology department was used to create pre-, middle-, and post-Challenge surveys. To allow for adequate response rates, the surveys were open to residents for over 2 weeks (Table 4). Two subjects submitted the pre-survey twice; in these cases, the latter submission was deleted from the data set. For use in this thesis, all subject identity data was removed to protect human subjects' rights.

Table 4.
Resident Survey Response Rates

	Pre-survey	Mid-survey	Post-survey
Responses (rate)	435 (18%)	523 (22%)	268 (11%)
Number analyzed	433	523	268

The mid-survey served as a reminder that GGC was occurring and as a tool to encourage critical thinking about actions[14]. Some pre- and post-survey questions were designed to determine effectiveness of educational methods[15]. The rest were designed to quantify differences between baseline and post-treatment behaviors (Table 5). The final question regarding learning from GGC was used to create a variable for correlation tests.

Table 5.
Resident Survey Questions and Possible Responses

Behavior assessment
In general, how many times a day do you take the elevator in your hall? never / 1 or 2 / 3 or 4 / 5 or more In general, how many times a day do you take the elevator in other buildings on campus? same as above How much of the time do you unplug your computer or turn off your powerstrips after you've used your computer? never / rarely / sometimes / most of the time / always How much of the time do you unplug your other appliances (TV, game player, microwave, etc.) after you've used them? same as above On average, how many times a week do you shower? Write in: On average, how long are your showers? up to 5 minutes/ up to 10 minutes/ up to 15 minutes/ over 15 minutes
Attitude Assessment
How would you describe most residents in your hall regarding their use of electricity? conservers / efficient users/ unaware / overly consumptive
Learning
Thanks to the Challenge, did you learn something about resources used on campus that you did not know before? yes / no

Questionnaires to Leaders

An evaluation of GGC was distributed to RAs and RDs on February 7th, 2008. By the time of study completion, 41 of 60 questionnaires had been returned, a response rate of 68%. Of these respondents 5 (12%)

[14] For mid-survey questions and/or results, please contact the author.
[15] Analysis of educational methods was conducted for a report to UR on GGC.

were ERs, 3 (7%) were RDs, and 33 (80%) were RAs. The 60 leaders who were sent the survey account for only 2.5% of the total population of the treatment halls, but are key to providing a check on the degree of implementation of the treatment (Table 6). Optional questions were included for purposes of improving future campaigns of the OS[16].

Table 6.
Open Ended Questions to Leaders

How did you spread the word in your hall about this Energy Challenge? Did you use different strategies with people that you know well, or have more of a relationship with, than others.
How many signatures did you receive, if you collected them for pledges?
What changes in behavior did you make and/or actions did you take?
Were there any behavior changes you asked your friends to make?
Were there any behavior changes that you observed or heard about?

Data Analysis

R, an open source statistical program, was used for analysis of the data. R allows researchers to write codes as they desire, and thus is a stronger program than some of the others available (Jordan Sly, personal communication, April 11, 2008). Kruskal-Wallis tests were employed to test changes in electricity use. Correlations were tested using the Pearson's correlation test.

The alpha (α) value chosen for the tests electricity use was α=0.05. The null hypothesis H_{01} will therefore be rejected if the probability of getting the observed difference by chance alone is less than 5 in 100. For the correlation tests concerning H_{02} and H_{03}, alpha was set at α=0.10. This higher alpha is justified, because even modest relationships between aspects of the treatment and energy savings and with each other are valuable; thus a higher risk of type I error is accepted in exchange for lessening the chance of not detecting a change when there actually was one. Further, since GGC was not well developed and refined, subjecting its effects to rigorous testing at this time would be premature.

Electricity use data

The Kruskal-Wallis test was used to look for a significance difference in the amount of change in electricity use due to treatment. Numbers from the 8 treatment halls were compared to those from the 8 non-treatment halls. Kilowatt hour per resident figures were used because they were closer to raw data than percent

[16] Analysis of this data is not in this thesis but is included in reports to UR and the OS.

change. This test, which ranks data for comparison, was desirable for use here because the samples did not come from a normal population, population variances were somewhat heterogeneous (Zar, 1999), and the degree of difference in reduction was more important than the actual differences between halls.

Graphs comparing various halls of similar design and population were used to show non-statistically tested effects of treatment on electricity use.

Relationships between variables

Correlation tests were used and variables were created (Table 7) to test hypotheses that certain aspects of GGC have no correlation with electricity use (H_{02}) or with each other (H_{03}). In both the pre- and post-surveys, residents were asked to classify hall mates as either conservers, efficient, unaware, or overly consumptive users of electricity. For analysis purposes, the first two choices were combined to form the "reported efficiency" variable. The last variable represents the increase (from pre- to post-survey taking) in percentage of residents who reported efficiency. Building design types were created from designations used by UR (see above Table 3). Designs 1, apartments opening to the exterior, to 4, double rooms with interior hallways, were assumed to provide ordinally increasing opportunities for social diffusion.

Table 7.
List of Variables Used for Correlation Testing among Treatment Halls.

% completed surveys
% signed the green pledge
% reported learning
% reported efficiency in post-survey
Difference in efficiency reporting from pre- to post-survey
% change in electricity use from baseline
Building design type

As a preliminary analysis, relationships between variables were visualized in a correlation matrix. Variables that exhibited the strongest visual correlation in graphs were further analyzed using the Pearson's Correlation test, which looks for simple correlation, or whether or not two variables act independently of each other (Zar, 1999). Since hypotheses H_{02} and H_{03} question the existence, rather than the strength, of correlation coefficients, no assumptions about the data must be met to use the Pearson's test (ibid). Factors limiting correlation testing include a small sample size (n=8 treated halls), lack of separation in the study design of halls according to building design and program implementation.

Behavior changes

To answer the question of the effect of GGC on behavior, pre- and post-survey responses to particular questions were originally to be analyzed for differences. For most questions, inadequacies in survey design, lack of differences found upon preliminary review of responses, and low response rate to the post-survey made statistical analysis for behavioral changes irrelevant. Behavior changes were therefore estimated by comparing differences in proportions of pre- and post-respondents' answers to questions. Recall other limitations to survey data listed in the Study Design section above.

Attitude changes

The main focuses of GGC and this thesis study were participation and electricity reduction. One question on the surveys to residents dealt with their attitude (see above Table 5). Changes in how residents considered each other as electricity users were estimated by comparing differences in proportions of pre- and post-respondents' answers.

Leaders' questionnaire data

Questionnaire data were analyzed using qualitative methods to consider the leaders' style of implementation. As one RA questionnaire was incomplete, 40 questionnaire responses were coded into a spreadsheet and then compiled into a table (see below, Table 9). The researcher created content categories by reviewing questionnaires as they were returned. Responses easily fell into the initial categories, i.e., methods and changes were straightforward and similar among leaders.

CHAPTER SIX

RESULTS

This chapter details the results of the statistical analyses used to test H_{01}, H_{02}, and H_{03}. Electricity use differences between treatment and non-treatment halls found using the Kruskal-Wallis test are presented first. Results among the individual treatment halls are then provided with figures for correlation variables. These results are discussed in more detail in Chapter 7. Results from correlation tests follow. Description of notable behavior changes and leadership implementation complete the chapter.

Electricity Use

The Kruskal-Wallis tests for differences in the mean (n=8 treatment, n=8 non-treatment) kWh per resident use from the baseline to the 2008 between the treatment and non-treatment halls showed significance (α=0.05, df=1) for each month. Therefore, the H_{01} was rejected. The X^2 and p-values for the January, February, and March data were the same, at X^2=4.4 and p=0.04. Figure 1 shows graphically the difference that the Kruskal-Wallis test proved significant. While reduction did occur in non-treatment halls, it was always greater in treatment halls.

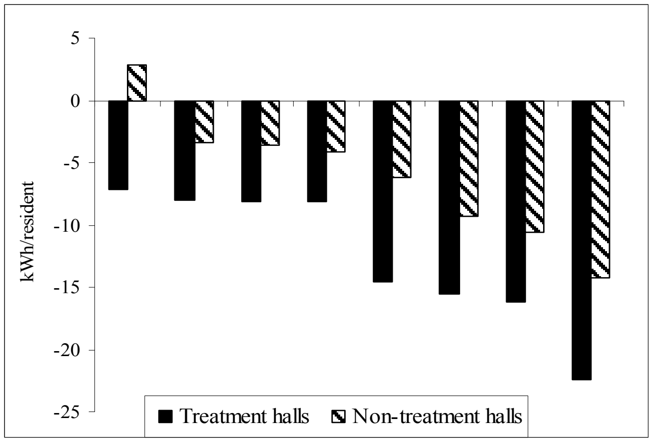

Figure 1.
Electricity Reductions from Baseline (average 2005-07) Use to 2008 Use Averaged Over the Study Period (Jan.-Mar.) for Treated and Non-treated halls, Ranked from Largest Decreases in kWh/resident to Smallest Decreases.

The average reduction in electrical consumption from the baseline to 2008 (with money saved) over the three-month period for all targeted halls was 12.5% ($9316) and for non-targeted halls was 6.1% ($1391). The largest reduction within treatment halls was in February (Figure 2).

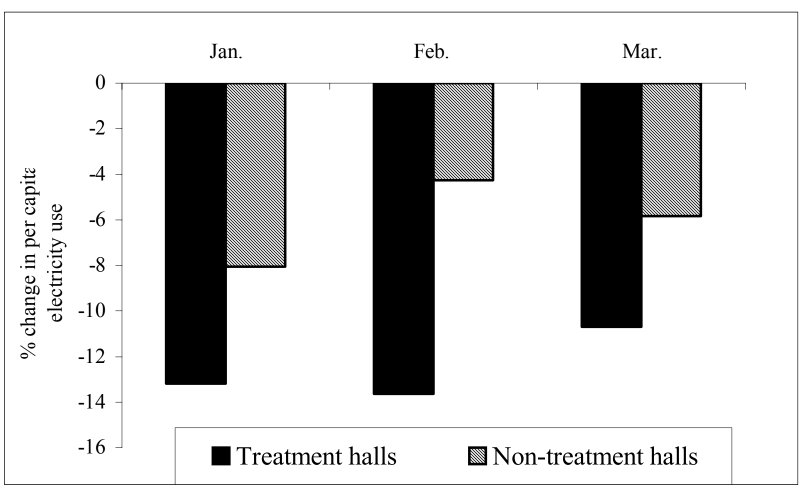

Figure 2.
Average Percent Change in Electricity Use Over the Study Period (Jan.-Mar.) from Baseline Use to 2008 Use for All Halls.

Comparing percent reduction of treatment and non-treatment halls with similar designs further indicates an effect of GGC (Figures 3, 4, and 5). Since designs are the same, that aspect can be assumed to have minimal effect at making consumption different.

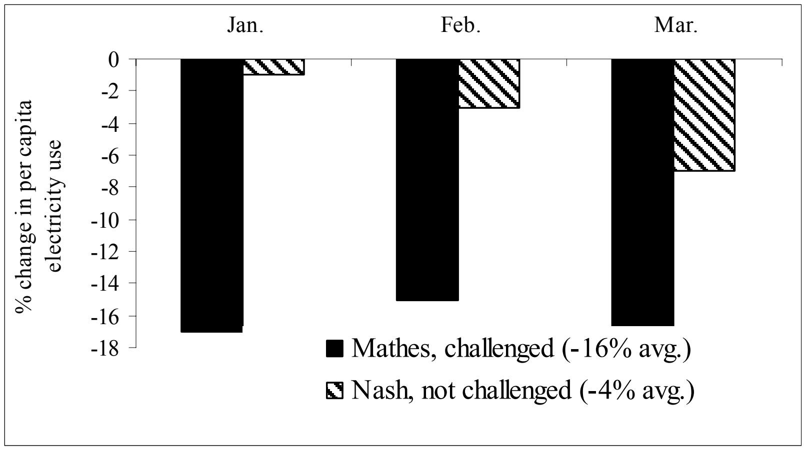

Figure 3.
Percent Change in Electricity Use for two Halls with the Same Design (corridors, interior hallways).

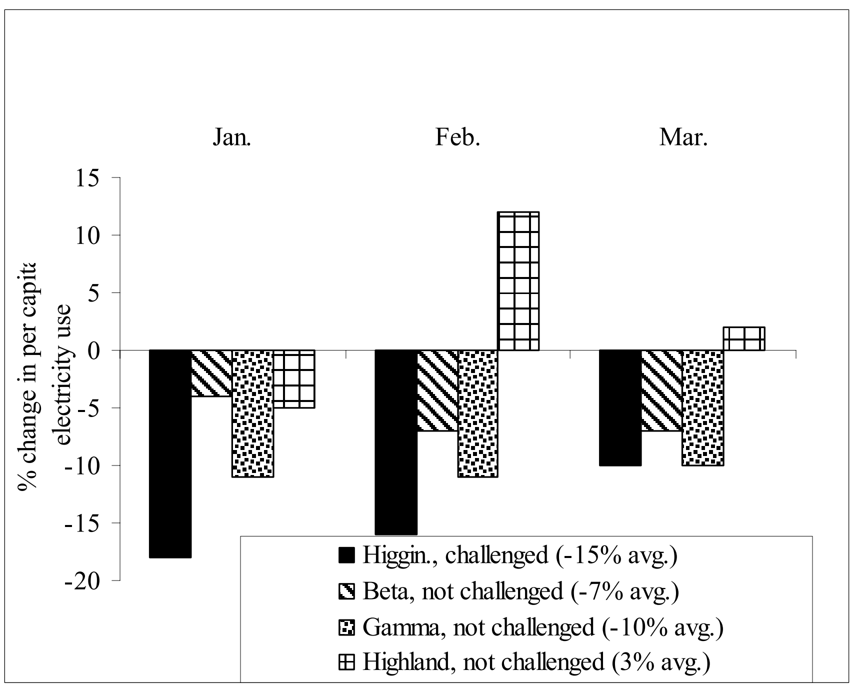

Figure 4.
Percent Change in Electricity Use for two Halls with the Same Design (suite, exterior hallways).

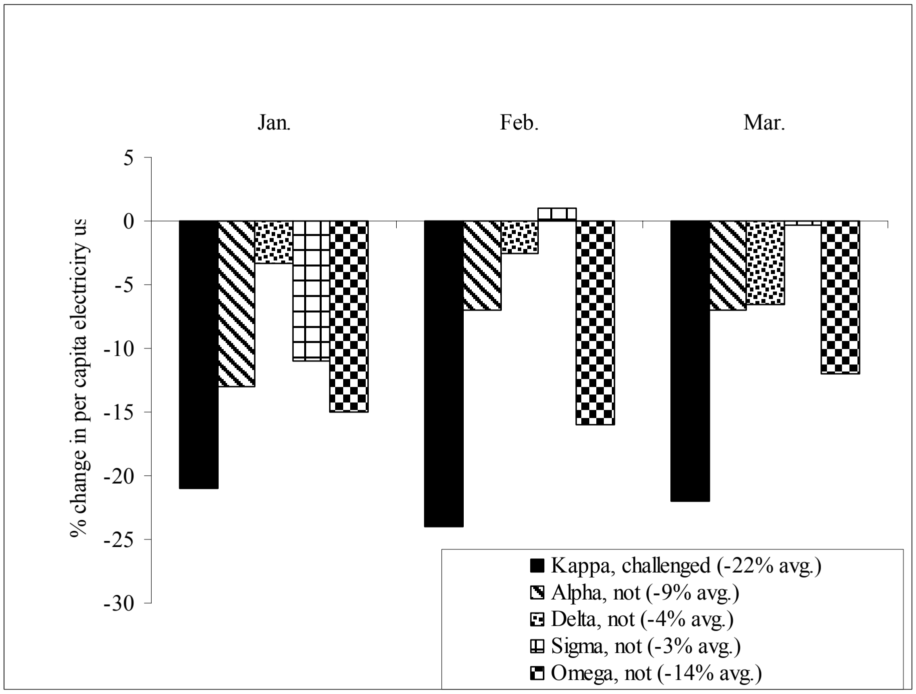

Figure 5.
Percent Change in Electricity Use for two Halls with the Same Design (corridors, interior hallways).

A glance at the reductions among the treated halls and the corresponding rate of certain variables (Table 8) reveals that some trends exist. For example, percents of residents reporting efficiency and learning were low as was average change in electricity in Birnam Wood. In Kappa this relationship was opposite.

Table 8.
Mean Electricity Reductions in Treatment Halls and Relevant Variables (all figures are percents).

Hall[a]	Mean reduction	Mean survey response rate	Pledge rate	Reported learning rate	Reported efficiency rate	Reported reduced appliance use	Reported turning lights off	Participation at hall events
E	7	21	48	63	17	20	33	14
BT	8	14	14	76	20	27	57	2
BW	8	7	0	52	5	24	45	9
EN	8	22	53	64	-3	19	25	15
H	15	26	46	64	20	49	76	13
F	16	13	36	62	12	66	98	4
M	16	24	74	66	16	57	98	2
K	22	23	38	79	28	41	60	31

a. E-Edens, BT-Buchanan Towers, BW-Birnam Wood, EN-Edens North, H-Higgingson, F-Fairhaven, M-Mathes, K-Kappa.

Relationships Between Variables

Pearson's Correlation tests found significant relations between specific variables, rejecting H_{02} and H_{03}. The highest Pearson correlation (α=0.10 for all correlation tests) was the mean survey response rate with the percentage that pledged (Table 9). Survey response rate correlated slightly, but not significantly, with electricity reduction.

Table 9.
Results of Pearson Tests for Correlation (α=0.10 for all tests).

Variable 1	Variable 2	t statistic	p-value
Mean survey response (%)	Electricity reduction (%)	-1.2	0.29
Difference in reported efficiency (%)	Electricity reduction (%)	-1.8	0.11
Efficiency reported in post-survey (%)	Electricity reduction (%)	-2.1	0.07
Mean survey response (%)	Pledge (%)	3.7	0.01
Reported learning (%)	Difference in reported efficiency (%)	2.3	0.06
Building design type	Electricity reduction (%)	-1.1	0.28

The correlation between electricity use and efficiency (classifying residents as conservers or efficient users of electricity) reported in post-survey was significant. A similar, but non-significant, correlation was shown using the difference in efficiency reporting from pre- to post-survey. Rates of reported learning something about electricity had a significant correlation with this difference.

Correlation of building design type and reduction was not shown to be significant. However, a closer look at the graphed results shows that there was a weak correlation and that the treatment was associated with greater reduction (Figure 6). The trend lines, created from the points for each group, suggest that electricity reductions are greatest among halls of design type 4.

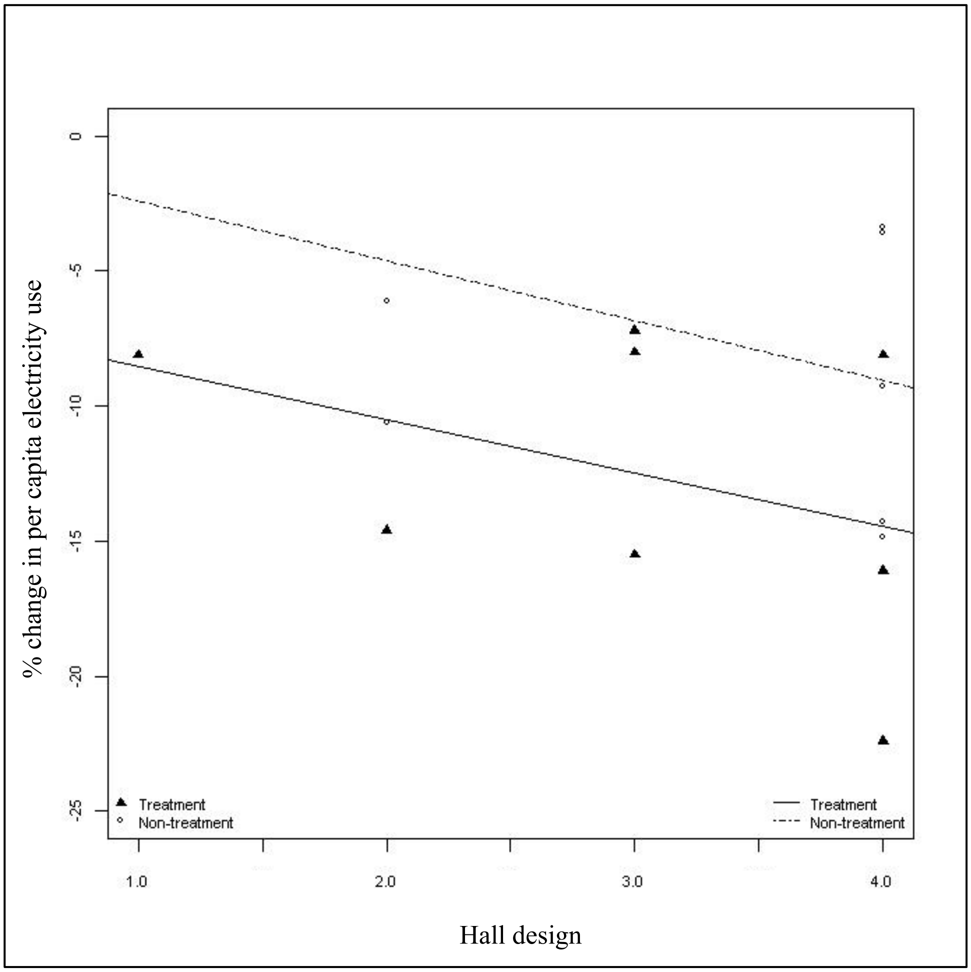

Figure 6.
Relationship Between Building Design and Percent Change in Electricity Use for all Halls, with Trend Line.

The matching slopes indicate that the relation between design and consumption is similar for all halls. The downward trend indicates that corridors with interior hallways (Type 4) are more efficient than apartments with exterior hallways (Type 1). The treated line being further down on the axis again shows that the treated halls had greater reductions in electricity use.

Behavior Changes

In the post-survey, 8% more respondents reported never taking hall elevators and 3% less were taking them over 5 times a day as compared to pre-survey respondents. Some residents may have started reducing the times they used hall elevators thanks to GGC. Some may have stopped elevator use. There are not data regarding use of elevators in non-program buildings. Specifically, reports of never taking the elevators increased 19% from pre- to post-survey in responses from Eden North, 12% in Buchanan Towers, and 12% in Edens.

The pre and post questions addressed unplugging appliances. The amount of people that reported "sometimes" unplugging increased and the amount that reported "never" unplugging decreased.

The mean number of showers per week reported in the pre-survey responses was 5.88 and in the post-survey was 5.71. Differences between pre and post- shower lengths were not found.

Attitude Changes

The percent of people classifying hall mates as efficient users went up 17% from pre- to post-surveying and the percent classifying them as unaware went down 18%.

Leadership Implementation

Kappa was the only hall in which the RD appointed a leader and built a promotion strategy for GGC. The most common tactics used by leaders to spread word of GGC were signage and verbal discussion, or talking to residents in person (Table 10).

Table 10.
Number of Uses of Diffusion Methods Reported by Resident Directors, Resident Advisors, and EcoReps.

	BT	BW	E,EN,H [2]	F	K	M	Totals
Floor meeting			xxxxxx			xxxxx	11
Word of mouth		x	xxxx	xxxxx	xxx	xxxx	17
Door to Doors		xxxx	x	x	xxxx	x	11
One on Ones			xxxxxx	x		xx	9
Bulletin boards, signs, flyers, posters		xx	xx	xxxxxx xx	xxxx	xxxxx x	22
Emails		xx		xx	x	x	6
Other methods[1]		xx	xxxx	xxxxxx	xxxxx	xx	19
Totals	0	11	23	23	17	21	95
# of leaders in hall	8	6	9	15	6	10	--
# of leaders who responded	0	6	8	12	5	10	--
Mean reduction	8%	8%	10%	16%	22%	16%	--

1. Included showing the website, highlighting the competition and prizes, talking about awareness, holding an eco-event, promoting the EcoReps' "Save the Planet, Start at Western" Facebook group, & tabling.
2. Since leadership is coordinated under one RD, results from leaders in these 3 halls are combined.

In addition to the methods listed above, the most varied amount of behavior changes, both made personally and asked of residents, were reported by leaders in Fairhaven and Mathes[17]. Overall, leaders reported

[17] To see detailed reports from leaders regarding behavior changes and observations, please contact the author.

mainly turning off lights and unplugging unused appliances as personal behavior changes. Similarly, changes most commonly asked of residents dealt with light and appliance use. Leaders most commonly reported observing changes in light use. The mid-survey contained a question about light usage, and nearly all respondents (94%) were making efforts to turn lights off more often. This adds validity to the leaders' self-reported changes and observations regarding light use.

CHAPTER SEVEN

DISCUSSION

Recalling the need for research on attempted behavioral interventions, this discussion focuses on the successes of GGC by highlighting (1) strategies that worked in halls with the largest electricity use reductions, (2) aspects of GGC that complemented each other and correlated with electricity use and (3) changed behaviors. Future campaign planners at WWU are encouraged to apply what worked in these halls to those that exhibited smaller reductions so that more significant reductions may be realized with future attempts. In this chapter, limitations are revisited before suggestions and final conclusions.

Successful Implementation

There was a significant difference in electricity reductions due to treatment. In other words, all leaders mobilized their efforts to achieve the goals of GGC: electricity reductions and participation. Qualitative data and general observations found that implementation varied greatly among halls, and consideration of uncontrollable factors like renovations and hall design further indicate why reductions varied among treatment halls.

Strong implementation in Kappa stemmed from the RD, who assigned duties to the RAs and adpoted GGC as the main program focus. Kappa stood out from the other halls in the amount of posted feedback given to the residents. Providing accurate feedback has been proven to help behavior change campaigns achieve desired outcomes (MacKenzie-Mohr & Smith, 1999). Prompts stood out in Mathes, where the RAs decided to unite efforts towards winning GGC. The large bulletin boards in Mathes and Kappa reminded residents about the challenge to a larger extent than in any other halls[18]. Signs in many places around the building reminded residents to turn off lights. Mathes RAs targeted both on electricity, putting signs by every light switch and

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[18] For photos of these bulletin boards, please contact the WWU Office of Sustainability.

elevator controls, and elevator and paper towel use. Spurring thought about more than one resource at a time may have caused more reflection and led to more behavior changes.

The RAs in Kappa and Mathes were the most involved over the entire GGC period. Fairhaven and Higginson had the next largest reductions; however some of the reductions were thanks to renovations in 2007 and 2006, respectively that increased lighting efficiency. Reductions were not due solely to implementation, as they were in Mathes and Kappa which had no recent renovations.

The design of Kappa and Mathes, corridors with double rooms and shared hallways and bathrooms, is conducive to both social diffusion and efficient use of electricity; the large reductions (22.4%, 16.1%) attest to this. In both halls, up to 30 residents share common bathrooms. This means modeling of target behaviors by leaders, or others, in the halls can be seen by the target audiences. Changing light use was easy in these halls, because light switches for hallways lights are accessible to residents. More residents reported turning off lights in Kappa (100%) and in Mathes (98%) than in any of the other halls. Design differences contributing to the greater reduction in Kappa are that Mathes has two elevators while Kappa has none and that the Mathes lab has seven computers and Kappa's has only one.

Implementation was successful in Edens, with high percentages of residents signing pledges (48%) and reporting learning (63%). Edens' residents made a short video, which the RD distributed online, that modeled unplugging appliances that use electricity when turned off. Since reduction was relatively low while implementation was strong, building design should be considered a barrier to reduction by behavioral changes. Edens (7% mean reduction) stands out from other hall designs in that residents occupy the second through fourth floors and administrative offices the first. The offices contribute to electrical use, and could make reductions in kWhs used per resident impossible past a certain level. This also explains why the reduction was not as great during March (4.1%). The effects of residents' actions are not as strong in March, because while they are gone for spring break the administrative offices continue normal operation. Edens, which also has an elevator, has the suite design, so residents are not as exposed to modeling of efficient actions nor do they have as much daily contact with leaders.

Finally, there is an obvious difference in the portion of residents attending hall events; the varying percentages (see above Table 7) imply success of various types of events, implementation levels, and marketing strategies. The halls with the least participation, Mathes (2%), Buchanan Towers (2%), and Fairhaven (4%), had only one event while all others had two. Fairhaven's event was in January, while all others were later in the quarter. Low turnout at the Mathes event, yet lots of pledging (74%) and reported learning (66%), implies that the event was simply not a priority for those residents who were involved in other ways. The design of Kappa's main event encouraged participation. All quarter long, Kappa residents were encouraged to form teams and make films about sustainability. The high turnout at this event alone exhibits the importance of involving audiences in hands-on projects that contribute to a sense of community and encourage creativity.

Complementary Aspects of the GGC & Relationships to Electricity Reduction

Data showed correlation between survey and pledging. This finding is encouraging to campaign planners, because it implies that participating in one aspect of an intervention may lead to other types of participation.

The relationship between pledging and electrical use was not significant, but consideration of halls separately suggests that a relationship may exist depending on implementation. In Mathes, 74% of residents pledged, (21% more than the next closest hall), and the average reduction was the second highest (16.1%). Buchanan Towers and Birnam Wood data exhibit the opposite case: few and no residents signing the pledge corresponded with the second and third lowest mean reductions.

Although the correlation was not significant ($p=0.11$), data indicate that electricity reductions were greater in halls with many residents considering their hall mates efficient users. Kappa, the hall with the greatest overall reductions, had the largest amount of respondents in both the pre- (62%) and post-survey (90%) classifying hall mates this way. Such a perception of conservation was not apparent in Birnam Wood or Buchanan Towers, and these halls had some of the lowest overall reductions (8%).

The finding that, in seven of the eight halls, more residents reported efficiency in the post-survey than in the pre-survey indicates that as time went by, aspects of GGC became more effective. More residents classified hall mates as efficient users and conservers of electricity after the program. Fewer residents were unaware of their electricity use thanks to GGC. Thus, the energy reduction program led people to (1) act in a way that at least appeared more efficient than prior to the challenge and (2) seem more aware of their electricity use. This finding is encouraging to campaign planners who hope that "as people start acting the part, they start becoming the part" (personal communication, Seth Vidana, April 23, 2008).

Increased reporting of efficiency did correlate significantly with higher levels of reported learning (p=0.06). This indicates that learning translated into behaviors that were observed by residents, and encourages leaders to continue education efforts. Implementers should try to continually foster an atmosphere of awareness and appreciation for electricity in halls.

Changed Behavior

Both leader questionnaire (41 respondents) and mid-survey data (523 respondents) reveal that light use was the largest personal and noticeable change in behavior. The four halls with the most reporting of reduced appliance use were the four with both the largest reports of efficiency and the greatest reductions (Table 7). This indicates that as residents in these halls were changing behaviors, others noticed and perhaps changed their own habits. Elevator use did not change significantly from pre- to post-reporting, nor did the amount of time residents reported unplugging appliances or showering. This may be a result of inaccurate reporting or because the respondents were either already engaged in efficient behaviors or likely to modify their behaviors. Inconclusive results suggest the need for structural changes or more intensive campaigns targeting hard-to-change behaviors.

Limitations & Mitigations

Because survey response was voluntary, pre- and post-respondents were not matched, and follow up with non-respondents was not conducted because of limits to interaction with residents, the study could not determine how respondents may have differed from the general resident population. Data were not collected to explain differences in values, beliefs, interests, or willingness to change. The sample is threatened by self-selection bias; respondents may represent only the residents most likely to make changes and participate in programs. Post-survey response was also relatively low, making extrapolations to the larger population even more difficult.

Significant correlation was difficult to determine because of the small sample size (n=8 treated halls) and the inability to separate halls according to building design and program implementation. Residents involved with GGC were not separated from others. Thus, interaction or imitation may have led to decreases in control halls.

To account for these limitations, alpha was set at 0.10 instead of the more common 0.05. This decreased the chance of not detecting real treatment effects and is justified for testing GGC in its first year.

Even small effects of the treatment are noteworthy and worth analyzing. Qualitative data from leaders and observations in the treatment halls provided data to explain various implementation levels and strategies and to supplement survey responses.

Suggestions for Future Campaigns

Future challenges should apply successful strategies from halls with large reductions to ones were such reductions were not realized, especially those for which design makes marketing strategies difficult to perform effectively. To ensure strong implementation, participating halls should have involvement from RAs as well as EcoReps or equivalent volunteer organizers. These leaders, or indigenous personnel (Geller, 1989), should be educated about social diffusion and CBSM methods. Behavior modifications targeted by GGC were ones that people living in a collegiate community can fairly easily make. Future campaigns could set higher goals, even targeting natural gas, water, and gasoline use as well. To increase effectiveness of a campaign, Residence Life could set goals for the residents, such as certain levels of reduction or participation, and offer positive consequences if those goals are reached (Geller et al., 1982).

Suggestions for Future Studies

Future studies should gather character-revealing information from participants so as to allow for generalizations to a larger population, pilot surveys before widespread distribution, use multiple methods to get higher response rates, and attempt to directly observe certain behaviors. Such future studies would ideally take place over two years, so that changes can be made to measurement and assessment tools after piloting. Longer studies could include a follow up survey to ex-residents to assess any long-term responses to the intervention (Geller, 1989). The residence halls' building design and characteristics of leaders are excellent variables for research. Other studies could look more closely at one or two specific variables, truly narrowing down the magnitude of effects on the chosen resource use.

Another need is to determine how to return the money saved to the halls with electricity reductions. Barriers to a simple transfer of dollars include determining to what extent exactly the residents' behaviors led to the reductions and deciding how the halls should spend the money saved.

Conclusion

Peer-to-peer education and efforts to change behaviors so that positive effects on the environment are realized require personal communication, establishment of individual relationships and mutual goals, and active participation by the target audience. The leaders of the Go for the Green Challenge mobilized, at various levels, around the challenge and its goals to meet these requirements. The target audiences were motivated and inspired by hall leaders and by each other. Despite the limitations of this study that were discussed above, the effect of the Challenge on electricity consumption and relationships between variables were found to be significant. This research and the efforts of WWU residents, which show that positive results can be realized in many different ways, inspire others to implement behavior change interventions.

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APPENDIX A

Questionnaire to hall leaders.

Name:__________
Hall:___________
RA or EcoRep or RD (circle)

First Month Evaluation!!!
SO MUCH reduction! WHY AND HOW???

So, 22 days of the challenge have passed. We are into February now!
We know there were drops in use, and we don't know how much is thanks to the challenge.
That's where you come in!
What matters most is what you did. This questionnaire will help us determine the effects of your efforts! You'll be getting another questionnaire in another month. Thanks for your time and honest responses!

Electricity use reduction, online survey response rates, & money saved from 2007

What amazing results. Way to go!	% change from Jan. 2007- kWh/ resident	# online kick-off surveys completed	% resident population completed survey	Winter Resident Pop-ulation	$ saved at $0.065 per kWh (may actually be more)
Kappa	-16.7	64	29	222	$ 383.0
Higginson	-16.4	60	27	220	$ 47.0
Edens & Edens North	-11.5	53	21	254	$ 432.0
Fairhaven	-24.8	96	15	620	$ 2,171.0
Buchanan Towers	-7.4	75	19	394	$ 408.0
Mathes	-5.5	45	15	299	$ 87.0
Birnam Wood	-7.6	43	8	515	$ 167.0
Average % reduction	**-12.8**			**Total $ saved**	**$ 3,695.0**

Publicity began with an email from President Morse, then you did the rest. <u>Please answer as many of these questions as you can, using the scrap paper attached if you need to:</u>

1) How did you spread the word in your hall about this Energy Challenge? What did you say to your friends in your hall? What did you say to residents that may not be your good friends?

1a) How many signatures did you receive, if you collected them for pledges?

2) What actions did you take? What changes in behavior did you make? Were there any behavior changes you asked your friends to make?

2a) Were there any behavior changes that you observed or heard about?

3) Do you plan on doing anything differently in February to continue promoting the Challenge?
Circle one: yes no maybe

4) How much did you enjoy working on the Go For The Green program in January?
Loved it / More than other programs / As much as other programs / Not at all / A little bit

5) Do you know more about campus energy (electricity and heating) than you did before Go For The Green?
Circle one: Yes No Maybe
Optional: What did you learn specifically?:____

6) Puget Sound Energy charges WWU about 8 cents for each kilowatt hour (kWh).
Can you explain a kWh to someone? For example: "I know my PC uses 150 watts when I play a video. So, I skip 2 hours of play one day and save 300 watt hours."
Circle one: Yes Maybe No

7) February's theme is Be the Change You See. We're making and putting videos online that show what we all do, modeling behaviors. Want to be in a video? Check here if yes ____

<u>Optional questions:</u>
What other questions would you ask of RAs if you were evaluating Go For The Green as a program?

Do you have any other thoughts on the first month of Go For The Green after looking at the data table above?

Thanks again very much for your time and support. Great job this first month! ~Kimbrough
Kimbrough Mauney, Coordinator Residents' RAP: Resource Awareness Program
The Office of Sustainability, Western Washington University
tel: 360-650-2011 email: resrap@wwu.edu

APPENDIX B

Complete pre- and post-survey with responses to each question relevant to thesis study. Introductions were included at the top of the page of the online surveys.

Pre-survey:

Introduction: Thank you for your time in taking this survey. Your participation counts towards your hall's Energy Challenge points and helps create successful future programs. Please be honest, and assured that your identity will not be revealed. Thanks again for your time and attention.

Q1. Please select the residence hall you live in:
Q7. Do you think you can reduce your electricity use in your residence hall during January, February, and March?

	y	%	n
BT	75	100	0
BW	39	91	4
E	33	97	1
EN	19	100	0
F	92	96	4
H	59	98	1
K	60	98	1
M	45	100	0

Q8. In general, how many times a day do you take the elevator in your hall (3 treatment halls do not have elevators: K, F, BW)?

Hall	Response	pre		post		
		n	portion	n	portion	diff
E	5 or more times	2	0.059	0	0.000	-0.059
	3 or 4 times	3	0.088	1	0.053	-0.036
	1 or 2 times	8	0.235	4	0.211	-0.025
	never	21	0.618	14	0.737	0.119
EN	5 or more times	0	0.000	0	0.000	0.000
	3 or 4 times	0	0.000	1	0.091	0.091
	1 or 2 times	7	0.368	1	0.091	-0.278
	never	12	0.632	9	0.818	0.187
H	5 or more times	1	0.017	0	0.000	-0.017
	3 or 4 times	0	0.000	4	0.075	0.075
	1 or 2 times	19	0.317	12	0.226	-0.090
	never	40	0.667	37	0.698	0.031
M	5 or more times	4	0.089	3	0.045	-0.043
	3 or 4 times	8	0.178	15	0.227	0.049
	1 or 2 times	12	0.267	21	0.318	0.052
	never	21	0.467	29	0.439	-0.027
BT	5 or more times	5	0.067	0	0.000	-0.067
	3 or 4 times	20	0.267	7	0.280	0.013
	1 or 2 times	35	0.467	10	0.400	-0.067
	never	15	0.200	8	0.320	0.120

Total responses

	pre		post	
	n	%	n	%
5 or more	12	5	3	2
3 or 4	31	13	28	16
1 or 2	81	35	48	27
Never	109	47	96	55

Note: In the pre-survey, Q10 and Q11 were modified after 58 survey responses had been submitted. The *original questions and the first 58 responses have been omitted from analysis.*

Q10. How much of the time do you unplug your computer or turn off your powerstrips after you've used your computer?

	pre		post		
Response	n	portion	n	portion	diff.
never	101	0.269	53	0.198	-0.072
rarely	147	0.392	90	0.336	-0.056
sometimes	66	0.176	78	0.291	0.115
most of the time	36	0.096	31	0.116	0.020
always	25	0.067	16	0.060	-0.007

Q11. How much of the time do you unplug your OTHER appliances (TV, game player, microwave, etc.) after you've used them?

	pre		post		
Response	n	portion	n	portion	diff.
never	135	0.361	68	0.254	-0.107
rarely	133	0.356	93	0.347	-0.009
sometimes	65	0.174	67	0.250	0.076
most of the time	23	0.061	27	0.101	0.039
always	18	0.048	13	0.049	0.000

Q12. On average, how many times a week do you shower? Write in:

	pre avg	post avg
Total	5.88	5.71

Q13. On average, how long are your showers?

	Pre		Post		
Response	n	portion	n	portion	diff.
longer than 15 min	48	0.111	35	0.131	0.020
up to 15 min.	171	0.395	97	0.362	-0.033
up to 10 min.	178	0.411	103	0.384	-0.027
up to 5 min.	36	0.083	33	0.123	0.040

Q14. How would you describe most residents in your hall regarding their use of electricity?

	Conservers				Efficient users				Unaware users				Overly consumptive			
	Pre		Post		Pre		Post		Pre		Post		Pre		Post	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
BT	2	3	0	0	19	25	12	48	50	67	13	52	4	5	0	0
BW	0	0	0	0	12	28	7	33	26	60	10	48	4	9	4	19
E	1	3	1	5	20	59	14	74	11	32	4	21	2	6	0	0
EN	0	0	0	0	11	58	6	55	8	42	4	36	0	0	1	9
F	4	4	1	2	44	46	25	59	42	44	13	31	7	7	3	7
H	1	2	2	4	31	52	36	68	27	45	14	26	1	2	1	2
K	3	5	4	14	35	57	22	76	23	38	3	10	0	0	0	0
M	2	4	3	4	22	49	44	65	19	42	18	26	2	4	3	4

Post-competition survey:

Introduction: Thanks for your time in completing this last survey, earning some final points for your halls. Your actions have made big impacts, saving over $7100 dollars and keeping 100,000 pounds of carbon dioxide from being emitted into the atmosphere. To celebrate your involvement please come to the UpFront Theatre Improv group show. They are performing on campus, FOR YOU exclusively, on April 8th at 8pm, tentative location: AH 100. Thanks again for your honest responses and participation!

Q1. Please select the residence hall you live in:
Q5. In general, how many times a day do you take the elevator in your hall? See Pre-survey above.
Q7. How much of the time do you unplug your computer or turn off your powerstrips after you've used your computer? See Pre-survey above.
Q8. How much of the time do you unplug your OTHER appliances (TV, game player, microwave, etc.) after you've them? See Pre-survey above.
Q9. On average, how many times a week do you shower? See Pre-survey above.
Q10. On average, how many minutes long are your showers? See Pre-survey above.
Q11. How would you describe most residents in your hall regarding their use of energy: conservers, efficient users, oblivious users, or overly consumptive? See Pre-survey above.
Q14. Thanks to the Challenge, did you learn something about resources used on campus that you did not know before?

	yes		no	
	n	%	n	%
BT	19	76	6	24
BW	11	52	10	48
E	12	63	7	37
EN	7	64	4	36
F	26	62	16	38
H	34	64	19	36
K	23	79	6	21
M	45	66	23	34

APPENDIX C

Sponsors and their donations. For contact information, please contact WWU's Office of Sustainability.

Community sponsor	Donation	Value
The UpFront Theatre	Free improv comedy performance at WWU	>$1000
Eagle Rock Challenge Course	Free day on high ropes course for 20 people	>$500
REI	4 Taku jackets, gift certificate	$2,111
AS Outdoor Center, WWU	Free Mt. Baker Climb, 3 free sunset kayak trips, 2 free rafting trips, Center-led trip exclusively for winning hall	~$400
Fairhaven Bike and Ski Shop	4 gift certificates	$100
Back Country Essentials	Free entry to Mt. Baker Hill Climb, misc. gear	~$95
Fairhaven Walkers and Runners	2 goodie boxes with gift certificates	$70
Community CoOp	2 gift certificates	$50
Yoga Northwest	Gift certificate	$50
Great Harvest Bread	Gift certificate	n/a
Fairtrade Haven	Lantern, ceramic piece	~$38
Colophon Café	Gift certificate	$25

APPENDIX D

Electricity data for all treatment halls. For detailed non-treatment data, please contact the author.

JANUARY RESULTS								
	kWh/res Jan. 2008	kWh/ res avg Jan. 05-07	% change from avg. Jan. 05-07 kWh/res	Jan 2008 total building KWh	Total bldg. kWh avg Jan. 2005-07	kWh saved (diff. b/w 2008 & average)	Money saved at $0.07132 per kWh	CO2 pounds saved
Kappa	135	171	-21	29,312	37,291	-7,979	$569	8,298
Higginson	114	139	-18	25,020	25,391	-371	$26	386
Edens	258	286	-10	38,180	43,030	-4,850	$346	5,044
Edens North*	174	167	-8	17,185	19,094	-1,909	$136	1,985
Mathes	114	137	-17	33,600	40,363	-6,763	$482	7,034
Fairhaven	198	234	-15	120,335	137,647	-17,312	$1,235	18,004
Buchanan Towers	182	196	-10	71,354	78,059	-6,705	$478	6,973
Birnam Wood**	120	129	-7	63,683	61,404	2,279	-$163	-2,370
Mean (1st 3 columns) & Totals	162	182	-13	398,669	442,279	-43,610	$3,110	45,354
Means & Totals, halls not challenged	*125*	*130*	*-10*	*159,632*	*169,587*	*-9,955*	*$710*	*10,353*
		FEBRUARY RESULTS						
Kappa	133	173	-24	28,928	37,675	-8,747	$624	9,097
Higginson***	113	134	-16	24,660	24,506	154	-$11	-160
Edens	251	274	-8	37,210	41,327	-4,117	$294	4,282
Edens North	161	176	-8	15,954	17,461	-1,507	$107	1,567
Mathes	116	137	-15	34,240	40,171	-5,931	$423	6,168
Fairhaven	216	264	-18	131,568	154,937	-23,369	$1,667	24,304
Buchanan Towers	180	205	-12	70,442	78,778	-8,336	$595	8,669
Birnam Wood**	111	120	-8	56,701	59,555	-2,854	$204	2,968
Mean (1st 3 columns) & Totals	160	185	-14	399,703	454,410	-54,707	$3,902	56,895
Means & Totals, halls not challenged	*126*	*132*	*-6*	*161,645*	*165,489*	*-3,844*	*$274*	*3,998*
MARCH RESULTS								
Kappa	117	151	-22	25,472	32,939	-7,467	$533	7,766
Higginson***	100	111	-10	21,830	20,361	1,469	-$105	-1,528
Edens	249	258	-4	36,800	38,960	-2,160	$154	2,246
Edens North	150	163	-8	14,854	16,236	-1,382	$99	1,437
Mathes	101	121	-17	29,568	35,456	-5,888	$420	6,124
Fairhaven	181	208	-13	110,208	122,705	-12,497	$891	12,997
Buchanan Towers	168	170	-2	65,733	65,865	-132	$9	137
Birnam Wood**	125	113	-10	57,817	62,069	-4,252	$303	4,422
Mean (1st 3 columns) & Totals	149	162	-11	362,282	394,591	-32,309	$2,304	33,601
Means & Totals, halls not challenged	*112*	*118*	*-6*	*141,734*	*147,438*	*-5,704*	*$407*	*5,932*
*January use is based on past 2 years, as meter broken in 2005.								
**The only past reading that is valid for Birnam Wood is from 2007.								
***While kWh per resident is lower in 2008, total building kWh is higher, because building housed 35 more residents than averaged in the past.								