UCLA Practicum in Environmental Science
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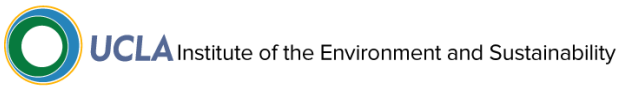
Incorporating Sustainability Across an Aerospace Manufacturing Enterprise

Cyclical Employee Engagement Program



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I. ABSTRACT

Northrop Grumman (NG), a leading global aerospace and defense company, plans to achieve its goal of 30% absolute reduction in greenhouse gas (GHG) emissions by 2020. Its efforts include embedding sustainability practices and carbon reduction mechanisms into the core of its business operations. Specifically, Northrop Grumman has asked the UCLA Environmental Science Senior Practicum Team to develop a plan for a long-term energy conservation program geared towards employee engagement. Through benchmarking studies, site visits, employee surveys, interviews, and quantification of GHG emissions, the team has gauged the scope of behavioral energy reduction efforts. As a result, the team has developed a cyclical program comprised of employee education, competition, innovation, and recognition that seeks to unify the NG's sustainability efforts with the corporate goals. This report also includes future recommendations beyond the scope of the program that will launch Northrop Grumman as a leader in sustainable business practices.

II. INTRODUCTION

GHG emissions, which are largely attributed to energy generation processes, significantly contribute to climate change and associated risks. The California Global Warming Solutions Act of 2006, known as Assembly Bill 32 (AB 32), requires California to reduce its GHG emissions to 1990 levels by the year 2020 to help mitigate risks associated with climate change, improve energy efficiency, and expand the use of renewable energy resources. In compliance with AB 32, companies located in California must adopt environmental strategies that will achieve technologically feasible and cost-effective GHG emission reductions.

Northrop Grumman Aerospace Systems is an international aerospace and defense company within the scope of AB 32, employing over 65,000 people and generating $24.5 billion in sales (Corporate Responsibility Report, 2013). In particular, the NG operations in Southern California are substantial, with over 16,000 employees and 8 million square feet of facilities, consuming roughly 40 megawatts of power annually.

In 2008, NG committed to mitigate its negative impacts on the environment by reducing its greenhouse gas (GHG) emissions 25%, normalized to sales, by 2014, relative to 2008 levels. By implementing energy efficient practices, such as reducing fuel use and replacing inefficient appliances and fixtures, NG achieved its GHG reduction goal two years ahead of schedule in 2013. NG's reduction goals currently include only Scope 1 (direct emissions from sources owned or controlled by the reporting entity) and Scope 2 (indirect emissions from consumption of purchased electricity) emissions. The company has now set an ambitious corporate goal of 30% absolute GHG reduction by 2020, relative to 2010 levels, and seeks to achieve this goal through innovative approaches that include sustainable employee practices.

UCLA's Practicum Team has examined additional strategies to reduce emissions related to human behavior in order to help identify additional reduction measures that can assist with meeting the company's goal. The team focused on researching (1) what programs can be designed and implemented to incentivize employee participation in energy use reduction, (2) the quantifiable impact in emissions reductions from changes in employee behavior, and (3) what future measures could improve the long-term benefits of the recommended program. This report outlines the methods used to research employee energy conservation practices, a summary of the

data collection, and the team's program recommendation based upon this research. We have also included our methods for quantifying potential GHG emission reductions from implementing the program.

III. METHODS

In order to address our three research questions and achieve our final goal of providing NG with an employee behavior-based energy reduction program, we conducted a benchmarking study, distributed an energy conservation survey, held interviews with current employees, and toured multiple facilities at Space Park. Our efforts aimed to give us a better understanding of the employee culture and community at NG. We simultaneously expanded our resources by conducting a benchmark study and visiting the Southern California Edison Energy Education Center. Lastly, we designed a method to calculate and quantify GHG emissions for the overall program recommendation.

A. Benchmarking Study

Benchmarking sustainability and employee engagement practices at a variety of businesses provided a wide spectrum of resources to inform our program recommendation. We drew information from both aerospace and non-aerospace companies, compiled the practices most applicable to NG, selected several ideas to inspire our program recommendation, and archived potential suggestions out of the scope of our project to NG in the "Future Recommendations" section of this report. Here, we summarize the findings that strongly inspired our immediate program recommendations.

Several of NG's major competitors, including Boeing, Raytheon, and Lockheed Martin, have implemented measures to improve their own environmental performance. For example, Raytheon determined that over 90% of its GHG emissions were attributed to energy consumption, addressing this through implementing energy efficiency projects, equipment upgrades, and initiatives addressing employee education and engagement. Noting that employees are generally unmotivated to save energy at work and more apt to practice conservation at home, the company developed a behavior-based energy reduction program rooted in the EPA ENERGY STAR "Work and Home" strategy. The engagement program was instrumental in helping the company reduce its overall energy consumption by 9% since 2008, with monetary savings of approximately $17M.

Lockheed Martin adopted a similar approach to Raytheon in engaging its employees in energy conservation. During Energy Awareness Month in 2012, the company ran a campaign to bolster employee participation in energy conservation efforts. Hundreds of employees participated in an energy conservation quiz, for which they were rewarded, and many employees were recognized as Energy Champions for outstanding efforts in energy conservation initiatives. In addition, Lockheed Martin established "Green Zones," in which employees in the same hallway or work area commit to energy conservation practices.

Also, all three of NG's main competitors use executive leadership and communication to drive their sustainability efforts. Specifically, Boeing and Raytheon publish clear messages from their executive leaders about the company's dedication to sustainability. In addition, Lockheed Martin operates a Corporate Sustainability Council, with specialized sustainability positions that

report directly to the CEO. The corporation's highest governing body, the Executive Leadership Team, assumes the responsibilities established by the Corporate Sustainability Council.

In addition to our findings from aerospace enterprises, the 3M Company, an American multinational conglomerate, inspired our group to leverage the creative potential of NG's employees in our program recommendation. Many of 3M's products, such as adhesives and display films, are the result of their own employees' innovation. This is driven by 3M's "15% Time" rule, in which employees to dedicate 15% of their time to developing new ideas and projects using the company's resources.

B. Site Visits

Our team visited Space Park to learn more about the workspace environment, tour the facilities, and interact with employees. Our first visit to Space Park included a presentation by the greeNG Energy Efficiency Tiger Team members and greeNG program personnel on their current sustainability goals and the overall expectations for the research project. After, we received a brief tour of one of the chemical laboratories and a few offices.

On our second visit to NG, we toured the F/A-18 assembly line, the Foundry, the Eagle Spacecraft lab, the Environmental Test, the Weather Wall, the James Webb Space Telescope lab, and the NGenuity lounge. Afterwards, we met with the Tiger Team to present our project proposal and to review the survey for feedback before it was finalized.

Our third and fourth visits to Space Park were for the purpose of conducting interviews with employees. In addition, we met with NG's Energy Manager and learned about the energy monitoring system on campus to better understand the existing infrastructure.

Additionally, we toured the Southern California Edison Energy Education Center. The tour covered a broad range of energy uses at home and in the business setting by emphasizing efficiency through a variety of lighting appliances and cooling and heating systems. Other topics discussed included Daylight Harvesting, an Automatic Sash Positioning System, and an Energy Management System (EMS). The information that we gleaned from the visit helped us provide future recommendations for energy conservation efforts at NG.

C. Energy Conservation Survey

We designed and distributed 15-minute energy conservation survey to identify current energy practices in an office setting at NG and to understand different motivators and incentives that drive employees' actions. The survey instrument had a total of 28 questions divided into 4 major focuses: Energy Conservation at Home, Work Environment, Personal Energy Conservation in the Workplace, and Energy Conservation Incentives. The survey was distributed electronically via NG's internal survey engine and online network; survey participation was voluntary.

The purpose of the first section, Energy Conservation at Home, was to understand employees' experiences with and mentality regarding energy conservation beyond the work environment, through their sustainable practices at home. The second and third sections, Work Environment and Personal Energy Conservation in the Workplace, gauged employees' environmental workplace customs in comparison to those at home. The fourth section, Energy Conservation Incentives, was designed to recognize potential rewards that could encourage

employee participation in environmentally related programs (e.g. energy reduction competition, workshops, events). Lastly, the survey included an open-ended section in which survey participants could share any ideas and thoughts that could improve NG's efforts in sustainability.

Survey Results

The survey was distributed to approximately 3,500 employees at Space Park and received 229 responses, a 6.5% response rate. Key highlights from the survey are discussed in this section **(**see **Appendix A** for a full summary of data**).**

1. Energy Conservation at Home

Our survey indicated that of all the respondents, 76% use ENERGY STAR appliances, 44% never unplug unused electronics and 72% always turn off the lights in an unoccupied space.

2. Work Environment

Our survey revealed that of all respondents, 40% reported that their peers never unplug unused electronics and 27% reported that their peers sometimes turn off lights in an unoccupied space. The survey results showed that 69% of all respondents selected "e-mail" as the form of communication that helps them become aware of NG's sustainability and energy conservation goals. As a result of the shared nature in the workspace, 53% of all respondents agreed or strongly agreed that they are limited in their abilities to save energy through practices such as turning off the lights or unplugging appliances.

3. Personal Energy Conservation in the Workplace

Our survey indicated that of all respondents, 62% take the stairs, 43% turn off lights in an unoccupied space, and 58% never turn off their computers.

4. Energy Conservation Incentives

Our survey suggested that of all respondents, 56% are motivated to save energy at home due to monetary savings and 33% are motivated by their desire to reduce environmental impact. In contrast, 50% are motivated to save energy at work by their desire to reduce environmental impact and 21% by self-satisfaction. The survey indicated that the most appealing reward to receive for winning in the energy saving competition was a catered lunch with the site manager, whereas the least appealing reward was certificate and public recognition. The majority, or 60%, of all respondents selected monetary bonus as the most appealing reward to receive if the company adopted their suggestion to reduce energy consumption and 66% selected certificate and public recognition as the least appealing. If work productivity were not affected, 70% of all respondents would be very likely to adopt environmental practices to reduce their energy consumption.

The open-ended question at the end of the survey allowed respondents to share any additional thoughts about energy conservation at NG. Out of all the comments, approximately 29% were lighting related, 15% were computer related, and 14% were power related.

Survey Analysis

The survey results were integral to the development of our program recommendations and provided critical information on the energy practices of an employee at home and at work. The results also provided us with some insights on incentives that could improve the effectiveness of our program.

The first section investigated employees' energy practices at home. With this data, we were able to gauge the respondents' level of environmental awareness and the motivating factors for their conservation practices. The high percentage of respondents (76%) who use ENERGY STAR appliances at home suggests that many employees are aware of energy efficiency since they have monetarily invested in conservation. Also, over half of employees responded that they always turn off lights in an unoccupied space. These findings suggest that employees are performing energy conservation practices on a daily basis at home, indicating that there is potential to transfer similar practices in the workplace.

The second section focused on individuals' perception of the extent in which their peers engaged in energy conservation at work. Of the respondents, 40% report never seeing their peers unplug unused electronics, and 27% of respondents sometimes see their peers turn off lights in an unoccupied room. This again affirms that energy conservation education had the potential to positively change employee behavior. However, 53% of employees agreed or strongly agreed that there were limited options to conserve energy due to the shared nature of the workspace. This was likely due to the inability of employees to turn off lights, which we learned through the survey comments.

The third section aimed to gauge employees' personal energy conservation practices in the workplace. Since the majority of all respondents reported that they took the stairs at work, we did not focus on elevator use in our program recommendation as a means to achieve energy reduction. Instead, we aimed to leverage their participation in energy conservation to influence their peers at work. Also, only 43% of respondents reported turning off the lights in an unoccupied space, further highlighting the challenge of achieving behavior-based reduction in workspaces with a shared or fixed nature. In addition, 58% of respondents reported never turning off their computers, which might be related to a number of factors. Some employees might hesitate to turn off their computers due to the increased startup time the next morning which might hinder their productivity. Also, the IT department frequently installs updates at night and requires that employees leave their computers on during off hours. This provided additional indication that fixed workplace factors posed a challenge to engaging in workplace conservation practices.

The final section helped us determine the spectrum of factors that could potentially influence employee engagement in energy conservation. The strongest motivator for employees to save energy at home was monetary savings, whereas the strongest motivator to save energy at work was the desire to reduce environmental impact. We anticipated that the dichotomy in motivating factors results from the fact that employees were not impacted by the monetary cost of utilities at work. As a result, employees might be more motivated to save energy at work if they were informed of the monetary savings they were helping the company achieve, and how these savings would be used in a way that benefited the company as well as the employees.

In addition, as this section revealed that the most appealing reward to receive for winning an energy saving competition was a catered lunch with the site manager, we concluded that top management had the potential to strongly influence the success of our program. We had

integrated this information into the summer awards and recognition portion of our program recommendation.

The majority of employees selected monetary bonuses as the most appealing reward if their personal suggestions to make NG greener were adopted. However, we recommended that the company consider the cost savings and the potential benefits of incorporating sustainability in the company culture with the institution of a recognition program. Lastly, 72% of respondents chose e-mail as the communication path that they received information about greeNG. This form of communication was likely to be the most effective for spreading awareness of our proposed program recommendations. We had decided to use e-mail as well as visual displays in shared spaces to better inform employees about the sustainable topics in our program.

Additionally, at the end of our survey, we provided an open-ended comment section for employees to share their additional thoughts on energy conservation at NG. Respondents voiced their concerns over a variety of sustainability topics, with most comments involving lights, computer, power, and temperature at NG. We used this information to choose what topics would be prioritized in our future program recommendations.

D. Employee Interviews

Following our survey, we conducted interviews with greeNG Employee Resource Group (ERG) in order to interact with employees, learn about their experiences at NG, and gain insight into the company culture. The interview questions consisted of four topics: Awareness and Communication, NG Community, Workplace Sustainability, and Environmental Programs.

In the first section, Awareness and Communications, we aimed to understand NG's different forms of communication and the company's effectiveness in raising awareness about the sustainability efforts throughout Space Park. In the second section, NG Community, we hoped to gain better understandings of employee interactions and the overall atmosphere at NG. In the third section, Workplace Sustainability, we aimed to gather employee perspectives on the incorporation of sustainability practices at NG and the impacts of a greener workplace. In the last section, Environmental Programs, we asked for employees' opinions and feedback on our team's drafts for potential programs and events. The questions touched upon suggestions for environmental topics, the interest level in participating in workshops and competitions, and the potential for collaboration projects.

Responses from the interviews were compiled in a table for comparison and provided our team with additional knowledge for the development of our program recommendation.

Interview Results

A total of 6 interviews were conducted as well as an additional interview with an employee from top management. This section will highlight important findings from our interviews.

1. Awareness and Communications

From the interviews, we learned that the company's slogan "The Value of Performance" was recently introduced a couple years ago and was widely accepted by many at NG. One interviewee mentioned that the slogan drives employees' productivity and the company's success. More than half of the employees interviewed were aware of NG's sustainability efforts

to reduce waste, conserve water, and reduce GHG emissions. Four employees reported that there was a disparity between communication from top management and employees. Currently, Inside Aerospace e-Newsletter was a common form of communication that informs employees about sustainability efforts and achievements at NG. One person acknowledged that changes in leadership often times shifted employee interests depending on the leader's focuses.

2. NG Community

Based on the interviewees' responses, we observed that the expanse of the campus at Space Park led to rapport between employees that was established mostly within buildings or floors. However, communication and exchanges between buildings were facilitated through the association to ERG groups. We also learned that employees who held executive positions mostly interacted with managers and did not have the time or opportunities to interact with employees from positions that were under site managers.

An important finding about the culture at NG was that there was a pronounced generation gap between employees. This gap was recognized by people's varying interests and activities within the ERG groups.

3. Workplace Sustainability

When prompted to discuss additional ways the interviewees could reduce energy use, the answers centered around recycling, increased control of the HVAC and lighting systems, and water conservation. Many of the suggestions focused on infrastructure changes rather than the adaptation of employee's attitudes and the making of conscious conservation efforts.

More than half of the interviewees responded positively to the suggestion of adding sustainability into individual performance assessment. They also advised caution on the measurement of such a requirement, as sustainability was hard to measure, especially when trying to consider an individual's actions separate from the group.

Additionally, the employees we interviewed were aware of the efforts of greeNG and conscious of its success towards reaching its goals.

4. Environmental Programs

Although NG holds Earth Day Fairs every year, interviewees said that they would be interested in programs with environmental topics such as renewables, water recycling, volunteer service for the environment, waste management, and sustainable foods. All of the interviewees said that they would find values in organizing workshops aimed to inspire and educate people about the environment. However, a common concern was the lack of available employee time. As for innovation jams, over half of the employees had never attended one, and commented that innovation jams generally attract the younger generation.

Interview Analysis

As previously discussed, the interviews were essential in complementing our survey results and served as a tool to tailor our program recommendation.

From our questions regarding communication, we were able to understand that we should capitalize on all of NG's means of communication - intranet, e-mails, newsletters, and posters - to raise awareness of the campaign. Correspondence from top management regarding efforts

towards conservation is key to confirm the importance of these goals and to peak employee interest.

Second, we acknowledge that our program recommendation must include components that will engage the older generation at NG as well as the younger employees. We recognize that, while some events will appeal to a certain group of employees over others, covering the entire scope of conservation efforts - through education, involvement, innovation, and recognition - is the only way that we can boost participation rates and make a change in behavior-based energy conservation.

Based on the answers concerning workplace sustainability, we believe that employees have much to gain from workshops and speaker events that will elucidate what ways an individual can conserve power in an office environment. Interviewees confirmed that they are willing and prepared to integrate sustainability into their job requirements, as long as guidance and structure is set in place.

Lastly, we received positive feedback from all the interviewees regarding our proposal for a structured program that unifies greeNG's efforts with NG's corporate goals and values. It is especially important to create a program that can be applied towards different conservation and sustainability efforts in the future.

We took note of the employees' concerns regarding the allocation of time during their workday to attend workshops, events, and conferences. While this is something we discussed during our interview with top management, the solution still needs to be addressed when we develop implementation suggestions.

IV. RESULTS

A. Program Recommendation

We propose a cyclical program titled, "The Value of Performance: Environment Edition," which will drive efforts to achieve a higher level of corporate environmental performance. The program title builds upon NG's guiding message, "The Value of Performance," which is well recognized and accepted by employees as determined by our interviews. Associating the program with this message provides a unifying framework between the company's core values and environmental efforts.

The program is composed of yearly campaigns that are to be repeated each year with a new suitable theme centered on sustainability. The theme will be chosen each year with regards to the goals described in the Corporate Responsibility Report.

Our recommendations focus on the first year-long campaign of the program, which will emphasize energy reduction to drive NG's GHG emissions reduction goal. The campaign will be called ***Power to Save***. This title has been chosen in order to emphasize the *energy conservation* focus of the campaign. Additionally, as this program is designed to influence employee's actions, we stress the *empowerment* of the individual to become self-aware of his/her own energy consumption and personal opportunities to conserve power.

Power to Save is composed of 4 seasonal components: Education & Outreach, Campus Engagement, Innovation & Design, and Recognition & Ceremony. The description of each component can be found below. Each component is meant to stimulate different incentives to drive environmental performance - educational workshops, candid communication, top

management involvement, goal setting, competition, peer influence, and reward and recognition programs. Most importantly, employee participation in the Power to Save campaign and commitment to achieving a high level of environmental performance will play an integral role in this campaign's success.

Fall: Delving into the Year's Theme

The Power to Save campaign will begin in the fall with a central focus on employee education and corporate outreach. Before employees are encouraged to increase pro-environmental practices at NG, it is important that they are given the opportunities to learn and explore about how human impacts have led to current environmental issues. Understanding the consequences of unsustainable behaviors will help motivate employees to incorporate green practices in their daily routines.

Education

The education component for the fall will include speaker sessions and workshop series that will promote and raise interests for the year's theme: Energy Conservation. To kick off the program, there will be a keynote speaker who is a well-known individual with great expertise in the field related to the year's theme **(Appendix B)**. The keynote speaker should highlight the importance of the theme in relations to the environment and should make connections between the relevance of the theme to the company's goals. The speakers will be recorded so that the podcasts can be shown to multiple NG campuses, as suggested during an employee interview**.**

Another part of the education component is a series of workshops. Workshops should be designed to be engaging and interactive to ensure that employees will have a worthwhile learning experience. The series should span throughout the fall season with at least one workshop each month. We recommend that NG invite representatives who are from companies like 3M or SoCal Edison to lead workshops that educate employees on sustainable practices and energy conservation in the workplace. Workshop presenters can vary from different organizations, consulting firms, or schools **(Appendix B).**

Corporate Outreach

Corporate outreach will include building partnerships with different institutions, establishing clear guidelines that incorporate aspects of sustainability throughout the recruitment and hiring process, and creating a website that serves as a hub for all information regarding sustainability efforts at NG.

We recommend that NG seek partnerships with universities and graduate schools as an outreaching strategy for collaboration and inspiration. While universities will get the opportunity to interact with Northrop employees, Northrop will gain useful additional resources that may help them achieve their sustainability goals **(Appendix B).**

New recruitment orientation training is an opportunity to teach new incoming employees the value of sustainability in the workplace. The human resources department is an important opportunity to communicate sustainability ideas to incoming employees. Company recruiters should make it a priority to search for individuals with environmental innovative thinking. The orientation training for newly hires can involve informing new employees about NG's sustainable efforts and goals. Employees are currently required to complete training modules for

various corporate topics. Including sustainability into a short 5-10 minute training module is a time efficient option for educating employees about sustainability and energy reduction.

Another form of outreaching is via online. We recommend that NG create a "Value of Performance: Environment Edition" website as a subset of the existing greenNG internal website. This will allow employees to learn about the program, yearly campaign, and all sustainability efforts at NG. Additional resources on the website will include webcast seminars and speaker sessions of environmental topics discussed in the Education section above. An important component of the website is a video archive for employees to view past videos of events, talks, or seminars they may have missed or want to watch it again. We have created a mock website based on the first campaign to provide a brief vision of the proposed website: uclangas.weebly.com.

NG should also outreach and connect with employees to increase employee engagement on campus by holding movie screenings, round-table seminars, and implementing departmental outings or volunteering events that promote sustainability. The new NGenuity theater room is a desirable place for movie nights about sustainable topics. New and existing departmental events will include a green component to further expose employees to sustainable work strategies **(Appendix B).**

Winter: Campus Engagement

During the winter, employees will apply their new sustainability knowledge by participating in a 6-month (January-June), campus-wide energy reduction competition titled, "Unplugged." The immediate goals of the competition are to promote employee awareness about energy conservation and to produce quantifiable GHG emission reductions. Ultimately, the Unplugged competition aims to stimulate widespread enthusiasm for energy reduction efforts by encouraging employees to make a conscious effort towards achieving a higher level of sustainability in the long-term.

Competition Logistics

Prior to the competition's start, widespread publicity efforts will create an atmosphere of anticipation. E-mails and flyers across the campus will advertise the upcoming competition, and top managers will make appearances to encourage employee participation. The Unplugged competition will also have its own dashboard, a subset of the greeNG internal website, where employees may obtain more details about the competition, pledge their commitment, and view real-time energy use data once the competition begins.

The Unplugged competition will fully utilize Space Park's existing infrastructure and capability for building-specific, real-time energy use monitoring **(see Section IV-B for a description of Space park's current metering system)**. Each building on Space Park campus will represent a team, and will establish an overall energy reduction target determined by the building's baseline energy usage. Employees will also be encouraged to pledge participation in the program, in which they commit to energy conservation practices relevant to their workspace. Each building will be led by a group of "Energy Enthusiasts" that will act as "cheerleaders" to ensure active participation throughout the competition. The Energy Enthusiasts will also constantly seek new opportunities to reduce energy in their buildings, and develop plans specific to their work environment.

Teams will have the opportunity to receive monthly recognition for their performances in several categories:

- ➢ Buildings' progress towards achieving their energy reduction goals*
- ➢ The overall quantity of energy reduced during the evaluation period*
- ➢ The greatest percentage of participation in the program, determined by the number of pledges (relative to building occupancy)*
- ➢ Improvements (percentage change) in energy reduction and pledges compared to the previous evaluation period

** Indicates a team may win the overall competition for this category*

Data Dissemination

Data dissemination will play an important role in fostering the spirit of competition and providing reinforcement for energy reduction efforts. Competition statistics will be reported and displayed:

- ➢ On digital flat screen television monitors in high-traffic areas, such as building lobbies and the cafeteria
- ➢ On the competition dashboard
- ➢ In regular weekly/monthly greeNG e-mails

Building-specific meters will record real-time energy use data and transfer it to a management system that will organize and report information in an easy-to-understand format. In order to provide participants with a concrete sense of their energy conservation efforts, energy reduction data will be reported in several forms: kWh, lbs CO_2 emission equivalents, and dollars saved. On the flat screens, the reformatted data will include updates of each building's' energy consumption and number of pledges, as well as statistics for the entire campus. The dashboard will contain more comprehensive information, with the capability to display each building's energy use history and to view trends over time. The information displayed on the flat screens and dashboards will be summarized in regular greeNG e-mails that highlight campus-wide reductions and the status of each building's energy conservation and pledges. For a sample of data displays for the competition dashboard, please refer to **Appendix I.**

Competition Conclusion

The overall Unplugged competition winners in the categories referenced above will be revealed at the summer awards ceremony. At the conclusion of the competition, the total energy reduced across the campus will be reported and used to determine the monetary savings from GHG mitigation. Benefits from repeating a similar energy use reduction competition in the future will also be projected.

<u>Spring: Think Different</u>

While the Unplugged competition will run through spring, the second half of the competition will have an emphasis on innovation and design by providing employees with opportunities to conceptualize large-scale and long-term energy reduction projects. The focus on innovation and design serves to promote the long-standing creativity and ingenuity of NG employees.

Employees from every department will have the chance to convene in groups and devise revolutionary ventures that could significantly reduce NG's environmental footprint. By gathering employees with diverse specializations in a structured event, we expect to generate innovative sustainable ideas that can be implemented across multiple NG sites. Through the following events, we hope to gather ideas and inputs from employees, as they are most affected by the sustainability efforts of the company.

NGENUITY Jam

"NGENUITY Jam: Environment Edition" will be based on the already existing *NGENUITY Jams* that have led to innovative ideas for NG in the past but with an energy efficiency theme. We propose the event to be held in April in place of the regular *NGENUITY Jam* and in collaboration with Connect1NG. Similarly to the current structure, the NGENUITY Jam will involve many groups of 6-8 people brainstorming solutions to increasing energy efficiency at NG, designing posters to raise awareness about the campaign, or working to improve existing practices. Similar to the existing NGENUITY Jams, each group will be led by an executive leadership member or a member of the Tiger Team. We propose that employees rank the type of executive leader they would like to work with and organize employees into teams with their top choices. This event will also highlight executive leadership's commitment to sustainability, which was mentioned in on-site interviews as a way to increase employee participation in sustainable action.

In addition to the on-site component of the NGENUITY Jam, there will also be a separate social media component of the event in order to continue the conversation for the long-term. Through the greeNG platform, online groups can be created to foster collaboration between employees from multiple NG locations across the country. The issues revolving around energy efficiency with be posted on the platform, and at a set time employees will log on and participate in solving problems. Although there will be an established end to the online event, the platform will remain open for employees to continue to come up with innovative ideas and move forward on making them a reality.

All outcomes of the NGENUITY Jam will be recorded and made accessible on the greeNG online platform.

Hackathon Event

In the spirit of healthy competition, inventathon-type events can be organized to further challenge innovation. Groups of employees will spend multiple hours working on specific environmental challenges that they are passionate about. These environmental problems may go beyond local site-specific challenges and address the environmental crises we face globally. The resources and creative minds gathered at NG have the potential to build revolutionary solutions when fostered by an appropriate environment. To incorporate the support of top management, the Hackathon groups will pitch their ideas to the executive leadership. Leadership will score each group based on ingenuity, environmental relevance, and its benefit to NG.

Compared with traditional problem solving and group decision-making techniques, the innovation-based approach offers significant benefits because it is focused around specific themes or challenges, as defined by management – hence avoiding non-productive and open-ended solicitations (such as suggestion boxes) or community discussions. It is also specific

to the groups invited to participate, which can include customers and suppliers as well as employees. The online component allows the events to be scalable beyond the limits of physical get-togethers, able to accommodate hundreds of participants. Lastly, these events are time-limited, allowing a concentration of attention and energy and preventing the process from fading into the background of business-as-usual. By utilizing the existing NG infrastructure for both innovation-based events, employees will more easily adjust their focus to sustainable action.

Summer: Recognition & Ceremony

The summer portion of the Power to Save campaign will serve as a culminating review process and a demonstration of the company's progress through a formal ceremony celebrating the year's achievements. Through a presentation of the findings generated from the Unplugged competition and announcements of the winners of the competition, Hackathon, and innovation jams, employees will feel motivated and personally affiliated with the company's accomplishments in sustainability through their individual contributions. Northrop Grumman will provide internal recognition through gifts and awards to acknowledge outstanding participants and to demonstrate the company's appreciation of employees' dedication to the value of performance. The overall winners of the Unplugged competition will also be recognized at this time. The buildings that reduce the most energy across the campus or have the greatest percentage of pledges will receive a catered lunch with a site manager, the most appealing incentive for winning the competition as indicated by our survey.

If NG management recognizes an exceptionally cutting-edge idea from the spring innovation component, they could potentially provide the innovator with the proper funding to fully explore the concept for implementation across the campus. The ceremony reception will increase cross-department interactions and conversation over the unified theme of environmentalism and sustainability. Upon completion of the ceremony, employees will have the opportunity to participate in a final survey evaluating the year's success in order to cultivate a self-sustaining program.

B. Quantification of GHG Emissions

In order to estimate GHG reductions resulting from implementing our program recommendations, we assessed various resources and techniques for quantifying GHG emissions. Initially, we determined that our overall approach to quantifying GHG emissions would be as follows:

1. Assess baseline year energy consumption at Space Park (kWh)
2. Determine the contribution of various energy consumption categories to each building's energy usage
3. Establish conservation scenarios that represent how employee practices can quantifiably reduce energy usage for the various consumption categories
4. Convert modified kWh values into lbs CO_2 emission equivalents and cost savings

Assess Baseline Year Data

Our team was provided with Space Park's building-specific energy metering data from December 2013 to February 2015. Each building at NG is equipped with an energy meter that feeds real-time data to a centralized Energy Management System (EMS). NG uses Schneider Square D PML ION 8600 electric kWh meters, an expensive, high-end, electric metering system that provides energy and power quality monitoring in the form of color excel charts for immediate export into Microsoft Outlook e-mails. The program software polls the meters every 2 seconds, presenting real-time data. NG uses these energy meters rather than the meters provided by Southern California Edison because these meters are equal to or better than the utility. This accuracy of the data was crucial for our baseline year calculations; we also recommend that the company fully utilize its existing infrastructure for the energy use monitoring during the Unplugged competition.

Determine Energy Consumption Categories

In order to address step #2, our team used an information sheet, *Energy Management Solutions in Office Buildings,* from Southern California Edison that contained general categories of electrical usage in the office environment: cooling (19%), ventilation (18%), lighting (28%), office equipment or computers (10%), other (25%). As these percentages are indicative of general Southern California office buildings, we applied these metrics to NG's buildings that contain solely office space, allowing us to determine the total pounds of CO_2 emission equivalents originating from each category. This separation provided a way to estimate the relative contribution of energy conservation behavior to each category (step #3).

However, some of NG's buildings house other work environments, such as labs and data centers, in addition to office space. Therefore, prior to the Unplugged competition we recommend the company uses specific metering to separate the relative contribution of the office components in these buildings, as we assigned arbitrary yet reasonable estimates for these values.

Establish Conservation Scenarios

To predict the achievable GHG reductions resulting from the energy reduction Unplugged competition, as well as potential cost savings from GHG mitigation, we estimated the average carbon dioxide reduction for each office building based on three pledge participation scenarios: Scenario A (high participation: 15% of the building's occupants pledge to participate in the campaign), Scenario B (average participation: 6%), and Scenario C (low participation: 1%). Although our literature review indicated that 20% overall reduction in energy usage can be achieved through conservation programs, we used 15% as a more conservative estimate based on NG's achieved energy savings during the energy crisis. The average case scenario, Scenario B, was chosen to reflect the response rate of our survey. Finally, the low-participation scenario, 1% participation, assumes that employees have a low-level of interest in pledging participation in the competition.

GHG Emission Reductions and Cost Savings

By applying these participation percentages to each energy consumption category, we can project the approximate reductions and cost savings the Unplugged competition can achieve. Based on Scenario B, which we used as the most representative scenario, we project that NG can

save approximately $120,000 from the Unplugged competition alone. It is important to note that although the fall and spring campaign have the potential to influence the company's GHG emissions and cost savings, we only used the competition as the basis for our estimates because it is driven by direct metered usage. For a sample of quantification calculations, and the metrics used to estimate these values, please refer to **Appendices C and D**.

Also, in the first year of program implementation, the Unplugged competition can only span 6 months as the fall component seeks to educate employees and generate excitement before the pledging period opens. We anticipate that re-launching the competition in future years will help NG further attain its GHG reduction goals. Therefore, the first year of the Power To Save campaign may be viewed as a pilot period to gauge potential success of continuing similar campaigns in future years.

In the future, NG may decide to apply other methods to quantify GHG reductions from energy conservation programs. The article *Household Actions can Provide a Behavioral Wedge to Rapidly Reduce Carbon Emissions* discusses how household behavioral changes, termed "intervention actions," can reduce GHG emissions. Although the combined energy conservation efforts of NG's employees are much larger than the actions that could be taken by a homeowner, the quantification methods in the study may potentially be applied to corporate employees. The methods discussed in this paper were beyond the scope of this project, but additional details may be obtained from **Appendix E.**

V. DISCUSSION

A. Program Implementation

As our senior project has come to completion, we, the UCLA Practicum Team, strongly recommend that the members of the greeNG Energy Efficiency Tiger Team implement the proposed Value of Performance: Environment Edition campaign. Considering the limited time frame of UCLA Environmental Science Practicum teams (20 weeks per project), greeNG would have a greater capacity to implement the program year-round and ensure the program's longevity. Additionally, current employees would have greater knowledge of NG's culture and corporate operations which will serve to adjust campaign specifics. We do nonetheless suggest that greeNG members establish partnerships with UCLA for assistance with the program, as described in this report. In addition, top management involvement will play an integral role in extending the program's success.

B. Campaign Budget Breakdown

The budget breakdown for the campaign was divided according to the four program components. For each section, we estimated the costs based on sources such as Amazon, Uprinting, UCLA Catering services, and Speakerpedia. The unit prices were the average of the market price. For events, we predicted an average of 30 to 50 attendees. However, values were subject to change due to vendor availability or varying prices. For example, some environmental films are available for free streaming online. Workshop materials and printing costs can also be reduced if an RSVP form is distributed prior to the event to obtain a better attendance estimate. Details of the items in each section are in **Appendix F**.

Campaign Component	Subtotal
Education and Outreach	$7,117.10
Energy Competition	$2,766.00
Innovation & Design	$1,726.00
Recognition & Ceremony	$12,333.20
CAMPAIGN COST ESTIMATE	$23,942.30

C. Measures for Success

The success of the Power to Save Campaign will be measured by several criteria throughout the year: employee participation count, event evaluation results, and number of pledges and quantity of CO_2 emission reductions from the Unplugged competition. Speaker sessions, workshops, the NGENUITY Jam, and the Hackathon will be evaluated at the end of each event by attendees via an evaluation form (see **Appendix H** for a sample). In addition, employees that attend the events will be required to check-in via an online form. The check-in system will help keep track of attendance count, employee performance points, and gauge campus-wide interest in the topic. Employee performance points that were earned throughout the Power to Save campaign will be totaled at the end of the campaign and will be used to recognize and award those that achieved a certain level.

At the end of spring, the Unplugged competition will be evaluated by the percentage of pledges received across the entire campus population and how the CO_2 reductions achieved contribute to NG's corporate GHG reduction goals. The energy conservation survey received 229 responses out of 3,500 distribution counts, so we project that the same response rate would achieve approximately 1000 pledges across the campus of 16,000 employees. Therefore, achieving 1000 pledges would indicate that the competition performed at the expected level. In order to achieve a higher level of success, we recommend raising the target participation to at least double the survey response rate. If a similar competition is repeated in future years, the target participation may be steadily increased to approach 100% of campus engagement.

The Unplugged competition will also be evaluated on how the achieved energy reductions contribute to NG's corporate GHG reduction goals. As mentioned in Section IV-B, continuing the competition for four years would allow for additional reductions and greater projected cost savings. For projected cost savings from the 6-month pilot period, please refer to **Appendix G.**

VI. CONCLUSION

In order to address today's environmental challenges, the U.S. government will continue to enforce regulation. Although AB 32 proposes immediate climate mitigation goals, more stringent regulatory policies will follow in the future. Our project provides Northrop Grumman with a stepping-stone in achieving both AB 32 compliance and preparing for a sustainable future.

Moreover, by providing human resources and educational outreach, our project will engage employees by prompting them to associate their appreciation of the "value of performance" with the concept of driving higher levels of corporate environmental performance. The energy use reductions from the campaign will help NG progress a step closer to achieving

their sustainability goal. Additionally, monetary savings will reflect in the company's overall finances, which could help sustain ongoing efforts to improve the company's sustainability efforts.

A. Project Challenges

We faced several challenges when working on our project. Given the clientele and sensitive nature of NG's work, any documentation leaving the campus had to pass through security clearance, a process that could take weeks to months. Due to this constraint, our preliminary timeline had to be adjusted to anticipate any delays.

Our second difficulty was determining how to quantify GHG emissions for behavioral changes, considering our inability to directly measure actions. Our preliminary literature review indicated that academic research was lacking in practical applications and program examples in the corporate setting. Therefore, we relied upon a resource from Southern California Edison to categorize office building energy consumption, and drew participation estimates from research studies that investigated energy conservation practices in homes. These methods, with appropriate corporate adjustments, were verified with David Coe, Space Park Environmental Manager.

B. Team Accomplishments

In order to conduct an analysis of baseline employee practices and the work culture at NG, we conducted surveys and interviews to gauge the employee population. The survey response rate was 6.5% of the Space Park employees (229 respondents). Out of those respondents, 7 interviews were conducted across a range of positions including an executive manager.

After collecting this preliminary data, we have proposed a cyclical, employee behavior-based energy reduction program with annual themes exploring employee education, engagement, innovation, and recognition. The program will help drive a higher level of corporate environmental performance and generate broad-based support for sustainability efforts. We have also created a mock website that serves to inform employees about the proposed campaign, Power to Save.

C. Future Recommendations

As a leader in aerospace engineering, NG continues to inspire innovation and drive technology forward through the company's "value of performance." Although our behavior-based program aims to drive forward through employee initiative, certain infrastructural changes could be implemented easily through corporate efforts, as indicated in the following list:

- ➢ Infrastructural upgrades through retrofits (LEED)
- ➢ Installment of cool roofs to reflect sunlight and reduce the heat island effect
- ➢ Active engagement in turf removal projects
- ➢ Life cycle approach to food items served in cafeteria

- ➢ Electric vehicle charging ports and enhanced ridesharing opportunities
- ➢ Partnership with Southern California Edison to identify and collaborate on sustainability solutions

Guided by the six company values of quality, customer satisfaction, leadership, integrity, people, and suppliers, Northrop Grumman continues to excel in performance and innovation. Considering the influence of these values in company decisions and actions, we recommend that corporate establish its commitment to environmental performance by introducing the value of sustainability as its seventh value. In doing so, the company will demonstrate to investors, customers, and employees alike that Northrop Grumman is not only committed to the quality of the end product, but also the initiative and social responsibility it is willing to take along the way. Propelled forward by an engaged, satisfied work force that recognizes the significance of environmental conscientiousness for future generations, Northrop Grumman will lead the way to a sustainable future.

VII. REFERENCES

2013 Corporate Responsibility Report: Executive Summary. Northrop Grumman.

Dietz, T., Gardner, G.T., Gilligan, J., Stern, P.C., Vandenbergh, M.P. (2009). "Household actions can provide a behavioral wedge to rapidly reduce US carbon emissions." **Proceedings of the National Academy of Sciences of the United States** 106.44:18452-18456.

VIII. ACKNOWLEDGEMENTS

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- ➢ Northrop Grumman
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  - ○ Lisa Chynoweth, *Space Park Environmental Manager*
  - ○ Katie Hamic, *greeNG Lead*
  - ○ David Coe, *Energy Manager*
  - ○ Brandon Florian
  - ○ Interview Participants: greeNG and executive management
- ➢ James Bassett, *Practicum Project Advisor*
- ➢ Noah Garrison, *UCLA Senior Practicum Coordinator*
- ➢ Southern California Edison
  - ○ Long Nguyen, *Energy Education Center*

IX. APPENDICES

Appendix A

Total Survey Response Rate at Manhattan Beach Space Park: 6.5%

SECTION A: Energy Conservation at Home

	Question	Top Response	2nd Highest Response	3rd Highest Response
1	Are you aware of your monthly household energy consumption?	Yes, and I use less energy as a result. **(48%)**	Yes, and I continue using energy in the same way. **(27%)**	No, I am not aware of my current household energy consumption. **(24%)**
2	On average, the monthly household energy consumption is 909 kWh per month or about $90 per month. Knowing this, how would you change your current monthly household energy consumption?	I already spend less than $90 on my electricity bill and do not need to change my consumption **(42%)**	Encourage other members in the household to conserve energy **(20%)**	Purchase or use more energy efficient products **(17%)**
3	Please check any energy efficient products that you use at home:	ENERGY STAR appliances **(80%)**	Compact Fluorescent Lights **(66%)**	Efficient windows/window treatment for better lighting and air circulation **(55%)**
4	How often do you unplug your unused electronics at home?	Never **(44%)**	Sometimes **(3-4 days week, 17%)**	Once in a while **(1-2 days a week, 16%)**
5	How often do you turn off the lights in an unoccupied space at home?	Always **(7 days a week, 72%)**	Usually **(5-6 days a week, 22%)**	Sometimes **(3-4 days a week, 4%)**

SECTION B: Work Environment

	Question	Top Response	2nd Highest Response	3rd Highest Response
6	Which of the following help you become aware of Northrop Grumman's sustainability and energy conservation goals?	E-mail **(69%)**	Inside Aerospace Newsletters **(46%)**	Signs, posters, banners, flyers **(44%)**
7a	Do your PEERS engage in the following energy conservation practices at work? Take the stairs	Sometimes **(30%)**	Always **(27%)**, Always-Sometimes **(27%)**	Sometimes-Never **(9%)**
7b	Unplug unused electronics	Never **(40%)**	Sometimes **(22%)**	Sometimes-Never **(20%)**
7c	Turn off unused electronics	Sometimes **(27%)**	Never **(19%)**	Always-Sometimes **(17%)**, Sometimes-Never **(17%)**
7d	Turn off lights in an unoccupied space	Sometimes **(27%)**	Always-Sometimes **(24%)**	Always **(19%)**
7e	Leave window blinds open for adequate lighting	N/A **(42%)**	Sometimes **(16%)**	Always **(15%)**
8	Which of the following do you see your PEERS using in the workspace?	Personal coffee machine **(63%)**	Mini refrigerator **(56%)**	Personal fan **(50%)**
9	On most days, I am satisfied with the room temperature in my workspace.	Agree **(28%)**	Disagree (**25%**)	Neutral **(22%)**
10	I would like to conserve more energy in my workspace, but certain appliances or factors are fixed and cannot be changed without upper management support.	Neutral **(35%)**	Agree **(20%)**	Strongly Agree **(19%)**
11	Due to the shared nature of my workspace, I am limited in my ability to save energy through practices such as turning off the lights when I leave or unplugging appliances.	Agree **(29%)**	Strongly Agree **(24%)**	Neutral **(18%)**

SECTION C: Personal Energy Conservation in the Workplace

	Question	Top Response	2nd Highest Response	3rd Highest Response
12a	Do YOU engage in the following energy conservation practices at work? Take the stairs	Always **(62%)**	Always-Sometimes **(16%)**	Sometimes (**12%)**
12b	Unplug unused electronics	Never **(33%)**	Sometimes **(16%)**	Always-Sometimes **(15%)**
12c	Turn off unused electronics	Always **(35%)**	Always-Sometimes **(26%)**	Sometimes **(18%)**
12d	Turn off lights in an unoccupied space	Always **(43%)**	Always-Sometimes **(27%)**	Sometimes **(14%)**
12e	Leave window blinds open for adequate lighting	N/A **(55%)**	Always **(25%)**	Always-Sometimes **(8%)**
13	Which of the following do YOU use in your workspace?	None **(43%)**	Mini refrigerator **(23%)**	Personal fan (**20%)**
14	How often do YOU use the following at work?	Never for all appliances (mini-fridge, heater, fan, etc.)		
15	On average, how many hours per day do you keep your computer on in your office? If you never turn it off, please type N/A.	Never turn off **(58%)**	6-9 hours **(22%)**	10-15 hours **(18%)**
16	On average, how many hours per day do you keep your monitor on in your office? If you never turn it off, please type N/A.	Never turn off **(60%)**	6-9 hours **(21%)**	10-15 hours **(19%)**
17-18	On average, how many hours per day do you keep your personal heater/fan on in your office? If you never turn it off, please type N/A.	Zero		

SECTION D: Energy Conservation Incentives

	Question	Top Response	2nd Highest Response	3rd Highest Response
19	At HOME, what motivates you the most to save energy?	Monetary savings **(56%)**	Desire to reduce my environmental impact **(33%)**	Self-satisfaction **(6%)**
20	At WORK, what motivates you the most to save energy?	Desire to reduce my environmental impact **(50%)**	Self-satisfaction **(21%)**	Northrop Grumman's sustainability goals **(18%)**
21	Which of the following forms of communication would you consider the most effective and impactful method to receive messages from Northrop Grumman's greeNG Employee Resource Group? (Check all that apply)	Email **(72%)**	Signs, posters, banners, flyers **(39%),** Inside Aerospace Newsletter **(39%)**	Direct managers **(27%)**
22	How interested are you in participating in a NGAS Building-Wide Energy Conservation Competition to see which building or department reduces their energy usage the most?	Somewhat interested **(27%)**	Neutral **(24%)**	Not interested at all **(19%)**
23	Which of the following would be MOST appealing to receive if your building wins an energy saving competition?	Catered lunch with site manager **(35%)**	NGAS promotional items (i.e. NG mug, padfolio, NG polo-shirt) **(27%)**	Eligibility to enter a drawing for an iPad Mini **(18%)**
24	Which of the following would be LEAST appealing to receive if your building wins an energy saving competition?	Certificate and public recognition **(45%)**	Eligibility to enter a drawing for an iPad Mini **(19%),** Catered lunch with site manager **(19%)**	NGAS promotional items (i.e. NG mug, padfolio, NG polo-shirt) **(19%)**

25	How interested are you in seeing a formal suggestion process to submit your ideas on how Northrop Grumman can reduce its energy consumption?	Somewhat interested **(35%)**	Neutral **(26%)**	Very interested **(23%)**
26	Have you ever contributed an idea to help Northrop Grumman reduce its energy consumption?	No **(83%)**		
27	Which of the following would be the MOST appealing to receive if your suggestion to reduce energy consumption is adopted?	Monetary bonus **(60%)**	Restaurant/retail store gift card **(22%)**	Free lunch **(6%)**
28	Which of the following would be the LEAST appealing to receive if your suggestion to reduce energy consumption is adopted?	Certificate and public recognition **(66%)**	Free lunch **(28%)**	Restaurant/retail store gift card (**4%)**
30	How likely would you be to adopt environmental practices to reduce your energy consumption if your work productivity was not affected?	Very likely **(70%)**	Somewhat likely **(18%)**	Neutral **(9%)**
31	How likely would improvements to make your workspace more environmentally friendly improve your quality of life at work?	Very likely **(36%)**	Somewhat likely **(32%)**	Neutral **(24%)**

Appendix B

Suggestions of speakers on Energy Conservation

- **Amory Lovins**
  - Founder of Rocky Mountain Institute
  - Leader in efficient energy use and sustainable energy supply
- **Dan Chiras**
  - Author of "Superbia: 31 ways to Create Sustainable Neighborhoods"
  - Consultant specializing in renewable energy and energy efficiency
- **David Orr**
  - Professor of Environmental Studies & Politics
  - Well known to be active in Environmental Education and Environmental Design
- **Denis Hayes**
  - One of the 100 "Heroes for the Planet" on *Time* Magazine
- **Terry Tamminen**
  - Director of the Climate Policy Program of the New America Foundation
  - Author of "Cracking the Carbon Code: The Key to Sustainable Profits in the New Economy" and "Lives Per Gallon: The True Cost of Our Oil Addiction."
- **William McDonough**
  - Architect
  - Author of Cradle to Cradle
  - Leader in Sustainable Development

Suggestions for Workshops on Energy Conservation

- **California Energy Commission**
  - Appliance Efficiency Regulations Website
- **Southern California Edison: Energy Education Center (Irwindale, CA)**
  - Long H. Nguyen | Senior Engineer, Energy Education Center
  - E-mail: long.nguyen@sce.com
  - Website to SoCal Edison Energy Education Center
- **Southern California Gas Company**
  - SoCal Gas Business Energy Savings Website
- **UCLA Smart Grid Energy Research Center**
  - http://smartgrid.ucla.edu/index.htm

Suggestions for Partnerships

- **California Polytechnic State University**
  - Civil and Environmental Engineering Industrial Affiliate Program
- **California Institute of Technology: Environmental Analysis Center**
- **UCLA Institute of the Environment and Sustainability**
  - Contact: Nurit Katz, the Chief Sustainability Officer at UCLA
  - Contact: J. Cully Nordby, Academic Director of the UCLA IoES
- **UCSB Bren School of Environmental Science and Management**
- **UCSD Sustainability Solutions Institute**

Suggestions for Movies

- "The Next Industrial Revolution" by William McDonough
- "An Inconvenient Truth (2006)," directed by David Guggenheim
- "Food Inc. (2008)," directed by Robert Kenner
- "Pump the Movie (2014)," directed by Josh Tickell and Rebecca Harrell Tickell
- "The Future of Energy: Lateral Power to the People (2015)," directed by Brett Mazurek
- "Earth On Fire (2014)" http://topdocumentaryfilms.com/earth-fire/
- "Inside the Garbage of the World (2014)" https://www.youtube.com/watch?v=LtoGdrkt9EY

Suggestions for Social Events

- LA River Kayaking/Safari
  - http://www.lariverkayaksafari.org/
- Tour UCLA's Cogeneration Plant
  - Contact: Nurit Katz
  - Details about UCLA's Cogeneration Facility
- Collaboration with environmental companies
  - Examples: Blue Zones, Pachamana
- Ted Talk Video Night with Discussion
  - The Other Inconvenient Truth
  - The Global Food Waste Scandal
  - How to Air Condition Outdoor Spaces

Appendix C

Kilowatt-hour values can be converted into lbs CO_2 emission equivalents by using the EPA eGRID factor. It is suggested that the GHG calculations use the latest EPA eGRID factor for WECC California which is 613.28 lb CO_2e / MWh. Using standard conversions, that equates to 0.000278 MT CO_2e / KWh. Given that NG purchases energy in bulk, our team used an assumption of 8.5 cents / kWh to estimate monetary savings of energy reductions.

Appendix D

Table 1: Sample GHG emissions quantification for an office building at Space Park, with average CO_2 emissions reduced in best, average, and worst-case scenarios

Building P			**Occupants: 296**		
Office electrical usage (kWh)	**Monthly Avg (Dec 2014 -Feb 2015) (kWh)**	**Monthly Avg Emissions (lbs Co_2e)**	**Scenario A** Monthly Avg Reductions (lbs CO_2e)	**Scenario B** Monthly Avg Reductions (lbs CO_2e)	**Scenario C** Monthly Avg Reductions (lbs CO_2e))
Cooling (19%)	48,991	30,045	4,507	1,803	300
Ventilation (18%)	46,413	28,464	4,270	1,708	285
Lighting (28%)	72,198	44,277	6,642	2,657	443
Office equipment (10%)	25,785	15,813	2,372	949	158
Other (25%)	64,462	39,533	5,930	2,372	395
Monthly Total	**257,849**	**158,133**	**23,720**	**9,488**	**1,581**

*Scenario A: 15% reduction, Scenario B: 6% reduction, Scenario C: 1% reduction
*Electricity (WECC eGrid factor): 613.28 lb CO_2e / MWh
*Cost assumption of $0.085 / kWh

				Average Monthly Savings for Conservation Scenarios (kWh)		
Building	**Average Monthly Energy Usage (kWh)**	**Estimated Percent Office Consumption**	**Office Consumption (kWh)**	**Scenario A: 15% Reduction**	**Scenario B: 6% Reduction**	**Scenario C: 1% Reduction**
A	**194,394**	50.00%	97,197	14,580	5,832	972
B	**147,625**	100.00%	147,625	22,144	8,857	1,476
C	**574,465**	0.00%	-	-	-	-
D	**591,990**	33.00%	195,357	29,303	11,721	1,954
E	**818,189**	25.00%	204,547	30,682	12,273	2,045
F	**1,149,288**	0.00%	-	-	-	-
G	**97,839**	0.00%	-	-	-	-
H	**521,427**	0.00%	-	-	-	-
I	**438,131**	50.00%	219,065	32,860	13,144	2,191
J	**963,690**	25.00%	240,922	36,138	14,455	2,409

K	**97,567**	100.00%	97,567	14,635	5,854	976
L	**1,012,398**	25.00%	253,099	37,965	15,186	2,531
M	**833,954**	25.00%	208,489	31,273	12,509	2,085
N	**218,062**	50.00%	109,031	16,355	6,542	1,090
O	**493,176**	33.00%	162,748	24,412	9,765	1,627
P	**257,849**	100.00%	257,849	38,677	15,471	2,578
Q	**178,149**	50.00%	89,075	13,361	5,344	891
R	**323,782**	50.00%	161,891	24,284	9,713	1,619
S	**497,557**	50.00%	248,779	37,317	14,927	2,488
T	**298,655**	0.00%	-	-	-	-
U	**2,481,716**	10.00%	248,172	37,226	14,890	2,482
V	**381,792**	50.00%	190,896	28,634	11,454	1,909
W	**359,838**	50.00%	179,919	26,988	10,795	1,799
X	**276,017**	0.00%	-	-	-	-
Y	**1,075,721**	20.00%	215,144	32,272	12,909	2,151
Z	**1,623,484**	15.00%	243,523	36,528	14,611	2,435
AA	**310,205**	50.00%	155,102	23,265	9,306	1,551
Total Energy Savings (kWh)	16,216,959		3,925,996	588,899	235,560	39,260
Total GHG Reductions (MT CO2)	4,508		1,091	164	65	11
			Savings per Month ($0.085/kWh)	$50,056	$20,023	$3,337
			6-Month Savings	$300,339	$120,136	$20,023

*Electricity (WECC eGrid factor): 613.28 lb CO_2e / MWh
*Cost assumption of $0.085 / kWh
*Conversion 0.000278 MT CO_2e / kWh

Appendix E

Estimating Emissions from Energy Conservation Behaviors

Scholarly articles quantify emissions by determining the potential emission reduction (PER) for each action, which is the reduction that would be achieved with 100% adoption of the defined action. The PER is then combined with the plasticity, the proportion of current non-adopters that might be incentivized to take action. The result is the reasonably achievable emissions reduction (RAER), which can then be used to quantify the amount of GHG emissions saved for each action (Deitz et al., 2009).

The Supporting Information of the Deitz et al. article also explores the calculations and estimations of GHG emission reductions from several sets of daily behaviors. In addition, current

penetration estimates (CPE), the percentage of the relevant population that adopted an emissions-reduction action, is discussed in the article. The article examines the following behaviors that are office building related: window coatings, space and water heater, thermostats, AC, etc. Also, the article compares regular-model appliances with their respective Energy Star Model eqivalents (i.e. refrigerator, window coatings, heaters), predicting the achievable GHG emission reductions from using the energy efficient models (Deitz et al., 2009).

Appendix F - Program Cost Estimate Breakdown

Item	Sub-items	Unit Price (average)	Quantity	Amount	Subtotal
EDUCATION & OUTREACH					
Honorariums for speakers	Speech (per speaker)	$5,000.00	1	$5,000.00	$5,300.00
	Transportation (per round trip for one speaker)	$300.00	1	$300.00	
Film screening fees	Single-Use Screening Rental	$300.00	2	$600.00	$600.00
Workshop materials and printing	Workshop program booklet	$9.74	30	$292.20	$737.10
	Posters	$14.83	30	$444.90	
Catering services	Catering (per person)	$12.00	40	$480.00	$480.00
				Education and Outreach Subtotal	**$7,117.10**
ENERGY COMPETITION: UNPLUGGED					
Flat-screen monitors	Screen board	$200.00	10	$2,000.00	$2,000.00
Outreach materials and printing	Flyers	$0.49	50	$24.50	$766.00
	Posters	$14.83	50	$741.50	
				Energy Competition Subtotal	**$2,766.00**
INNOVATION & DESIGN: EMPLOYEE ENGAGEMENT					
Outreach materials and printing	Flyers	$0.49	50	$24.50	$766.00
	Posters	$14.83	50	$741.50	
Event set-up	Decoration (per person)	$12.00	40	$480.00	$480.00
Catering services	Catering (per person)	$12.00	40	$480.00	$480.00
				Innovation & Design Subtotal	**$1,726.00**
RECOGNITION & CEREMONY					
Catering services	Catering for event (per person)	$16.20	50	$810.00	$5,610.00
	Free Catered lunch for winning teams or buildings (per person)	$16.00	300	$4,800.00	
Event set-up	Decoration (per person)	$12.00	50	$600.00	$600.00
NG promotional items and gift certificates	Promotional items	$10.00	50	$500.00	$531.00
	Gift certificate	$0.62	50	$31.00	

Event pamphlets and certificates (printing)	Event pamphlets	$9.74	50	$292.20	$292.20
Honorarium for keynote speaker	Speech (per speaker)	$5,000.00	1	$5,000.00	$5,300.00
	Transportation (per round trip for one speaker)	$300.00	1	$300.00	
Recognition & Ceremony Subtotal					**$12,333.20**
POWER TO SAVE CAMPAIGN BASELINE COST ESTIMATE TOTAL					**$23,942.30**

Appendix G-Forecasted Cost Savings

Scenario	Energy Savings (6 Months, kWh)	Monetary Savings (6 months)
A	3,533,396	$300,339
B	1,413,359	$120,135
C	235,560	$20,023

*Cost assumption of 8.5 cents/kWh
**Scenarios A and B cover all material costs of program. We assume that Scenario B is the most representative situation.

Appendix H - Sample Speaker Session/Event Evaluations

Speaker Session Evaluation

INSTRUCTIONS

Please rate aspects of the workshop on a 1 to 5 scale:
1 = "Strongly disagree," 3 = "Neither agree nor disagree," 5 = "Strongly agree."
*Choose N/A if the item is not appropriate or not applicable to this Speaker Session. Your feedback is sincerely appreciated. Thank you.

Section A: CONTENT

1. I was well-informed about the objectives of this speaker session.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
2. This speaker session met my expectations.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
3. The content is relevant to my current practices in the workplace or at home.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

4. How did you find out about the event?
    a. NG newsletter (e-mail mailing list)
    b. Banners and posters
    c. Employee resource group (ERG)
    d. Coworker(s)
    e. Other: _____
5. Why did you participate in this speaker session?
    [Free response]

Section B: SPEAKER

1. The speaker inspired me with novel ideas.
    [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
2. I would attend future speaker sessions if they covered similar topics to that of today's session.
    [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

Section C: SPEAKER SESSION RESULTS

1. I will apply what I learned in this speaker session to my workplace or home practices.
    [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
2. The speaker session was a good opportunity for me to learn more about this topic.
    [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
3. Do you feel your participation in the speaker session impacted you personally? If so, what are some immediate steps or actions you can take?
    [Free Response]

Section D: ADDITIONAL COMMENTS

1. How would you improve this speaker session? (Check all that apply.)
    a. ___Provide more information prior the speaker session.
    b. ___Clarify the speaker session objectives.
    c. ___Reduce the content covered in the speaker session.
    d. ___Increase the content covered in the speaker session.
    e. ___Update the content covered in the speaker session.
    f. ___Improve speaker session organization.
    g. ___Slow down the pace of the speaker session.
    h. ___Speed up the pace of the speaker session.
    i. ___Shorten the length of the speaker session.
    j. ___Prolong the length of the speaker session.

2. Please share any additional comments or recommendations to improve this speaker session.
    [Free Response]

3. Are you interested in receiving more information about speaker sessions from greeNG?
    a. Yes
    b. No

i. If yes, please leave your name and e-mail address here:_____
_____

Workshop Evaluation

INSTRUCTIONS

Please rate aspects of the workshop on a 1 to 5 scale:
1 = "Strongly disagree," 3 = "Neither agree nor disagree," 5 = "strongly agree."
*Choose N/A if the item is not appropriate or not applicable to this workshop. Your feedback is sincerely appreciated. Thank you.

Section A: WORKSHOP CONTENT

1. I was well-informed about the objectives of this workshop.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
2. This workshop met my expectations.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
3. The content is relevant to my current home or workplace practices.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
4. The workshop activities deepened my understanding of the topic.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
5. The activities in this workshop were relevant and applicable to my current practices.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
6. The pace of this workshop was appropriate.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
7. How did you hear about the event?
   a. NG newsletter (e-mail mailing list)
   b. Banners and posters
   c. Employee resource group (ERG)
   d. Coworker(s)
   e. Other: _____
8. Why did you participate in this workshop?
   [Free response]

Section B: WORKSHOP INSTRUCTOR (FACILITATOR)

1. The instructor was well-prepared.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5
2. The instructor was helpful to my understanding of sustainability.
   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

Section C: WORKSHOP RESULTS

1. I accomplished the objectives of this workshop.

   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

2. I apply what I learned in this workshop to my home or workplace activities..

   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

3. The workshop was a good opportunity for me to learn more about this topic.

   [ ]1 [ ]2 [ ]3 [ ]4 [ ]5

4. Do you feel your participation in the workshop impacted you personally? If so, what are some immediate steps or actions you can take?

   [Free Response]

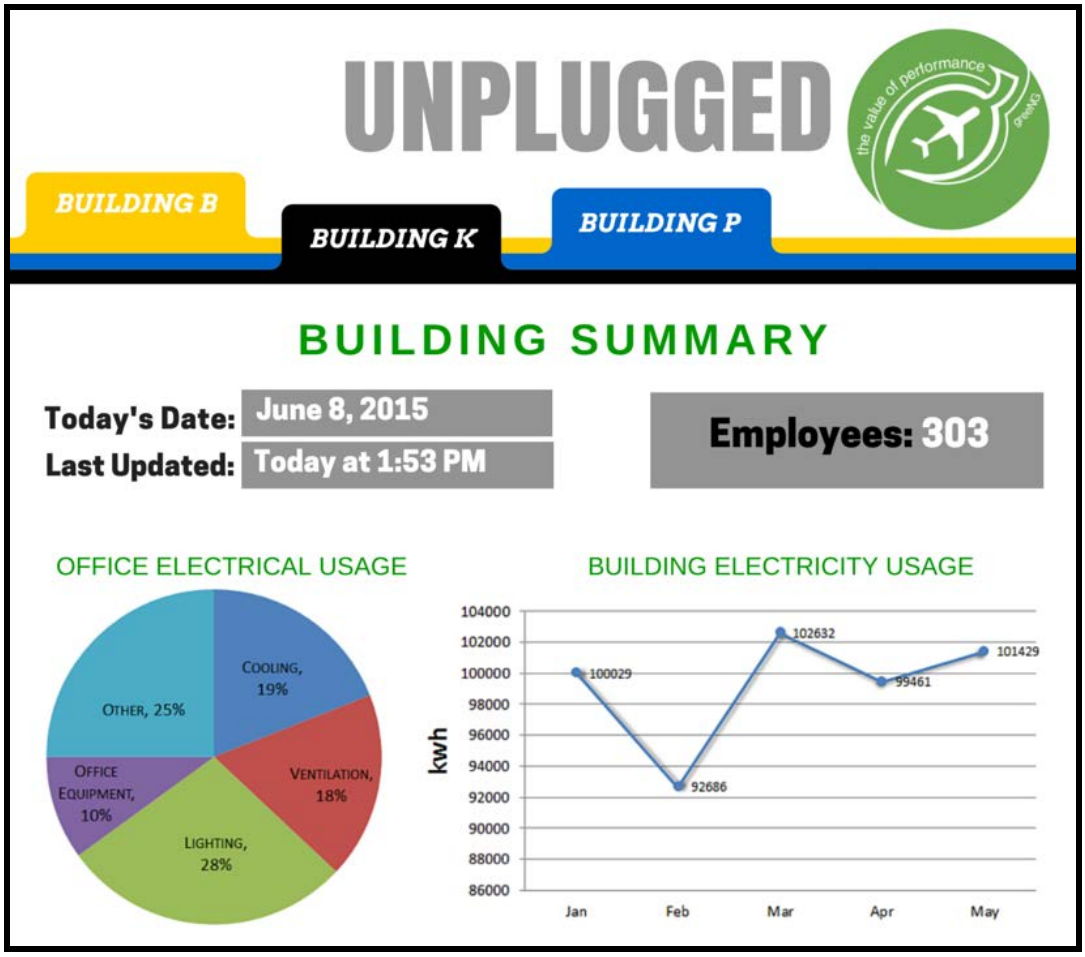
Section D: ADDITIONAL COMMENTS

1. How would you improve this workshop? (Check all that apply.)
   a. ___Provide better information before the workshop.
   b. ___Clarify the workshop objectives.
   c. ___Reduce the content covered in the workshop.
   d. ___Increase the content covered in the workshop.
   e. ___Update the content covered in the workshop.
   f. ___Improve the instructional methods.
   g. ___Make workshop activities more stimulating.
   h. ___Improve workshop organization.
   i. ___Make the workshop less difficult.
   j. ___Make the workshop more difficult.
   k. ___Slow down the pace of the workshop.
   l. ___Speed up the pace of the workshop.
2. Please share any additional comments or recommendations to improve this workshop.

   [Free Response]

3. Are you interested in receiving more information about educational materials/workshops from GreeNG?
   a. Yes
   b. No
      i. If yes, please leave your name and e-mail address here:_____
      _____

Appendix I-Sample Data Display: Unplugged Competition Dashboard



BUILDING COMPARISONS

JAN | FEB | MAR | APR | MAY | JUN | JUL | AUG | SEP | OCT | NOV | DEC