Proposal Title: Power Stripping and Reducing Rutgers' Energy Consumption

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Student Name: Syed Y. Hyder
e-mail address: syed.hyder@rutgers.edu
Major: Mechanical Engineering
Minor: Economics
Planned graduation Month and Year: May 2019
Mailing address: 1535 BPO WAY Piscataway, NJ 08854
Contact phone number: (908) 249-3029

Student Name: Tara Viray
e-mail address: tara.viray@rutgers.edu
Major: Public Health
Minor: Biochemistry
Planned graduation Month and Year: May 2019
Mailing address: 4590 CPO Way New Brunswick, NJ 08901
Contact phone number: (732) 675-0110

Faculty advisor name: Mitsunori (Mitch) Denda
Title: Professor
e-mail address: denda@rutgers.edu
Department: Mechanical and Aerospace Engineering
Campus phone number: (848) 445-4391

Proposal Summary:

Our team plans to implement smart power strips into all the on-campus residence halls before the start of the upcoming 2017-2018 academic year. These smart power strips prevent standby power consumption - which is the electricity a device consumes when it is "off", but still plugged in. At approximately $10 per power strip, they can save around 5,000,000 kilowatt-hours and $540,000 per year. These power strips will change how the average student consumes electricity, and is a simple yet efficient way to save energy, money, and the environment.

I. Introduction

Little changes in large quantities can have a significant impact. Our team believes that this is true for energy usage at Rutgers University – New Brunswick. Energy is undoubtedly being consumed throughout the day and with approximately 16,000 resident students, 136 residence halls, 6 student centers, 19 libraries – including some that are open 24 hours a day, it is pivotal to conserve energy. The wastage of energy by one individual is often overlooked as something trivial. However, minor changes that are implemented by an entire community can have compelling results. One example of wasteful energy usage is standby power, which is also known as a vampire load. Standby power is the energy consumed by devices when they are not actively being used, but still plugged into a power source. This power usage is often overlooked because either a person is unaware of the energy use or he or she does not believe it is worth the effort and inconvenience in order to save a few dollars per month on energy costs. However, our team estimates that on a larger scale (university wide), standby power consumption rapidly accumulates and uses a significant amount of Rutgers' energy and money. Our plan is to reduce the amount of energy that students use by reducing standby power use. This can be accomplished by implementing smart power strips that will shut off unused devices and thus benefit the environment and reduce Rutgers' energy bill. This small addition to a student's daily life can be implemented quickly, with minimal impact on his or her daily activities.

II. The Overlooked Issue

When looking to save energy, many people who are aware of the environment and its conditions will either overlook the standby power problem or believe that the effort to find a solution is not worth the gain. However, this is not true as it is estimated that standby power is "5 to 10% of residential electricity used in most developed countries" and that it is "roughly

responsible for 1% of global CO_2 emissions". Also, with our plan there is little to no work involved to stop vampire loads. A single device uses very little annual electricity, but when this little amount of energy is multiplied ten-fold, as it is in the case of Rutgers, the evidence is clear that a small energy use can become a big issue. One example is the microwave and fridge units that come with each residential room at Rutgers. An unused microwave that has its door closed and is plugged in 24 hours a day can use about 26.98 kWh per year or about $2.94 per year if it costs Rutgers about $10.90 for 1 kWh (New Brunswick energy costs). They might seem like incredibly underwhelming numbers however when considering that there are about 16,000 residential students, and let's say that about 2 people have one microwave, then total standby cost for a simple microwave is about $23,520 per year and uses about 215,840 kWh per year - and that's only one simple device. When considering that the average residence hall has countless other devices that use much more power and are powered longer, with some being 24 hours a day, it is evident that yearly standby energy usage can easily be in the hundred-thousands of kilowatt-hours, for a one of the 136 residence halls found on campus.

III. The Goal

The initial goal of our team is to equip each on campus residence hall dorm room with a smart power strip by the start of the upcoming 2017-2018 academic school year. The plan is simple because in order to save energy all a student has to do is have it plugged into the power strip and turn off the device. The cost of the power strips will eventually be outweighed by the amount of energy saved overall. This data can be measured in terms of the wattage which is found in the tables below. This goal is achievable and realistic as students are already told to purchase power strips, and these cost approximately the same amount as a regular surge protector. In addition, this goal can be achieved in a timely manner as installation of the power

strips would be less than 5 minutes because all the student needs to do is plug it into an outlet, and plug his or her devices to the smart power strip. Our team knows that the success of our goal will affect Rutgers positively and results would be feasible within one year of implementation of the smart power strips.

IV. Implementation

Our plan is meant to be simple and easy to implement. We desire quick changes that can immediately save energy. While we cannot expect students to unplug a device every time they are no longer using it; students will turn off or power down the devices when they are no longer in use. There are a few ways to accomplish this. One way to accomplish our goal of no standby power wastage is by utilizing a special type of power strip/surge protector. There are countless power strips in the market that have systems that will deliver no power to devices that are in the "off" position. These have different outlets that certain devices would be plugged into. Devices that need constant power, such as refrigerators, are plugged into a section of the power strip that constantly provide power; while other devices, such as a speaker system, is plugged into a "controlled" or "switched" section. The "controlled" or "switched" sections stop any current from going to the device when it is turned off. For example, when a TV is turned off by remote the power strip knows that the device is "off" and will not give it any more power.

Our team has developed a few possible ways to utilize and implement these power strips into every dorm room at Rutgers:

1. Rutgers students living on campus are already currently required to bring their own surge protectors to use in their rooms. Therefore, it is not unreasonable to require students to bring and use one of these special surge protectors that will help make Rutgers more environmentally friendly. Theses cheap surge protectors can sell for as little as $10.00 on

online sites such as Amazon, and should be of very minimum difficulty to get for the majority of students.

2. Rutgers could also buy the surge protectors themselves and have them already plugged into the dorm outlets. Rutgers could definitely buy the power strips in bulk buying each of them at a much lower price than $10. This cost could be covered by Rutgers or added on to student's term bill. As we have stated earlier, one device on standby can cost upwards of $10 per year, which itself will cover the cost of the power strip. Besides even the environmental side, such a plan will be more convenient for the students as they do not have to go out and get their own power strips, which are completely needed with the amount of devices the average student needs to plug into one outlet. Thus, many students will not object for a minimal increase in housing cost for the increase in convenience and positive effect to the environment. Such a plan has proven to work, right here at Rutgers, with the newly introduced Cupanion bottles. The bottles were given to each student for free, if they had a meal plan, even though each bottle is valued at about $8.00. From a college perspective, our team notices that these bottles are greatly used amongst students. Additionally, if Rutgers provided these power strips, they could keep them for years in the dorm rooms, making them a onetime purchase that has a long-lasting effect. Lastly, Rutgers could also buy more power strips, if they are already getting them in bulk, and use them all over the countless other areas on campus. This system can be used from the dining halls to the offices to the computer labs and save countless amount of standby energy that Rutgers consumes.
3. Another similar solution is for Rutgers to self-design a device such as "100% off" that was designed by Good for You, Good for the planet. The designing of such a device

could be done by the electrical engineering students of the Rutgers School of Engineering. This way a device could be made primarily for Rutgers needs.

V. Energy/Cost Savings

1 kWh cost: $0.109

Residential Areas

Table 1: Large Devices that definitely will be on the new system

Device	Standby Watts (Joules/Sec)	Hours Plugged in per day	Energy Saved/year (kWh/year)	Money Saved/year
Television	3.06	24	26.81	$2.92
Washing Machine	3	24	26.28	$2.87
Dryer	1.5	24	13.14	$1.43
Microwave (Door Closed)	3.08	24	26.98	$2.94
Desk Lamp	1	24	8.76	0.96
TOTAL Savings/year (16,000 residents/2) = 8000 devices			815,760 kWh/year	$88,960

Table 1: The devices in the table are noticeably plugged in for the full 24 hours of the day. The wattage was determined through background research. The energy saved/year and the money saved/year were determined through calculations, which are found in section V. Energy/Cost Savings.

Table 2: List of Possible devices on the new system

Device	Standby Watts (Joules/Sec)	Hours Plugged in per day	Energy Saved/year (kWh/year)	Money Saved/year
Keurig/Coffee Maker	6	24	52.56	$5.73
Musical Instruments (off)	2.82	24	24.70	$2.69
Surge Protector (off)	1.05	24	9.198	$1.00
Stereos/Speakers	24.58	24	215.32	$23.49
Cell Phone Charger (Cube)	1	24	8.76	$0.96
Video Game Console	11	24	96.36	$10.51
Charged Laptop	29.48	6	64.56	$7.04
TOTAL Savings (16,000/2) = 8000 devices			3,771,664 kWh/year	$411,360

Table 2: The devices chosen for this table were considered to be other plug-in devices commonly used by on-campus students. The wattage was determined through background research. The energy saved/year and the money saved/year were determined through calculations, which are found in section V. Energy/Cost Savings.

Non-Residential Areas

Table 3: List of Possible devices on the new system

Device	Standby Watts (Joules/Sec)	Hours Plugged in per day	Energy Saved/year (kWh/year)	Money Saved/year
16 Computer Centers HP Z1 Computers (~45 computers per lab)	2160 (3W per computer)	8 (Computer off overnight)	6307.2	$687.96
Printers	140,000	7	357,700	$39,016

(~3500 printers throughout Rutgers New Brunswick for student use)	(40W per printer)	(When printers are not being used at all/overnight)		
Total Savings			364,007.2	$39,703.96

Table 3: These devices were chosen because they are commonly used by all on and off campus students. The wattage was determined through background research. The energy saved/year and the money saved/year were determined through calculations, which are found in section V. Energy/Cost Savings.

VI. How the Numbers were Calculated

The numbers in the tables above were calculated in the following processes. First, background research was done to find out the average standby power consumption of the particular device. For the vast majority of these values, many of popular devices have already been determined by reputable institutions such as the Lawrence Berkeley National Laboratory and the Department of Energy's Pacific Northwest National Laboratory. The power values given were in units of watts, which are joules/second, or how much energy the device consumes in one second. We educationally estimated the number of hours in a day a device is plugged in, due to the lack of support in these evidences. Some devices are noticeably plugged in for the whole 24 hours in a day, for example, a washing and drying machine, lamps, and microwaves; but other devices were more difficult to estimate such as charged laptops and coffee machines because of their variability for each individual person. The Table 1 depicts the devices that are almost likely to be plugged in for 24 hours a day and can 100% be put on the new system of smart power strips, while the Table 2 depicts the devices that might be in a typical dorm room and can be implemented into the new system. After the average power (watts) of a device and its typical time plugged in was determined, we were able to calculate the energy a certain device uses in a year. The energy was formatted in kilowatt-hours (kWh) because this is the unit most commonly

charged by energy companies. The energy (kWh) was determined by the equation: $E_{(kWh)} = P_{(W)} \times t_{(hr.)} / 1000$ where t is equal to hours in a year. Finally, the cost per year for a device could be calculated with the equation: $Cost_{(\$/yr.)} = E_{(kWh/yr.)} \times Cost_{(cent/KWh)} / 100_{(cent/\$)}$ where cost per kilowatt - hour was made to be $0.109. This value was determined by using the cheapest quoted electric rate given by *power2switch.com* for the New Brunswick area. Therefore, the values given in the tables are on the more conservative end and could potentially save even more than the values given if the cost per kilowatt - hour is greater than $0.109. The values for each device was then added up and multiplied by 8000 as there are about 16,000 residents on campus and it is fair to assume that at least every two people share these devices.

VII. Analyzing the Data

The data in the tables can be organized and interpreted in a way that will project the overall savings the power strips will produce. In a year, a student will save approximately 5,000,000 kilowatt-hours and $540,000. Over a traditional course of 4 years, a student will save 20,000,000 kilowatt-hours and $2,160,000. This outweighs the one-time payment of $10 for the power strip. Since it is reusable, there is no need to buy a new one every year. Overall, the implementation of smart power strips is very cost efficient and this is evident in the data.

VIII. The Effects

The implementation of the smart power strips will positively affect Rutgers - New Brunswick in a myriad of ways. Directly, the amount of energy the university consumes will be reduced significantly and leave a smaller carbon footprint. The implementation of power strips across the campuses will give Rutgers an environmentally friendly reputation as a college that has “gone green”. This is the first step in cutting out more standby energy consumed by the university. The new system can be implemented in parameters outside of our research because

their plugged-in duration was too complex for our purposes. The amount of money that Rutgers saves on energy by using these smart power strips can be used to fund other energy saving initiatives and further reducing energy consumption. Through these processes, the use of the smart power strips can be fitted to other sources that use electricity - like the automatic or motion-sensing lights, and can be expanded to the far ends of Rutgers' energy consumption.

In addition to spurring reduced energy consumption, one important contribution is that the power strips will induce a new mindset in students. Many students are not aware of all of the electricity they consume because they do not directly receive an electricity bill. The power strips would cause students to be more self-conscious of the devices they are using and how to save energy and money for when they enter the real world, when they will have to pay an electricity bill. This mindset will be carried with them in their life after college. Overall, these power strips will entice the students and faculty to turn off their devices when not in use saving electricity, money, and the environment.

IX. References

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