APS in Dorms: A New Application for Savings?

Laura Drexel, Lara Bonn, Lauren Morlino, and Emily Kinghorn
Vermont Energy Investment Corporation

ABSTRACT

The average U.S. household now has 25 different consumer electronic devices. Even though most are reasonably efficient, the sheer number used for home entertainment and for home offices has created increased plug load (Urban, Tiefenbeck, and Roth 2013). Advanced power strips (APSs), which eliminate standby power to devices, can reduce up to 10% of the total energy use of a home (Earle and Spam 2013). Utilities have been running APS promotions for use in the home, but what other opportunities are there for savings? An efficiency utility answered this question with two metering studies in student dormitories at the University of Vermont. Many dorm rooms host both entertainment and home office equipment—TVs, gaming systems, DVD players or other video equipment, computers, monitors, printers, not to mention other gadgets like cell phones, chargers, and tablets. With this mix of home electronics and home office equipment, using APS in dorm rooms can create measurable savings that could enable utility efficiency programs to claim savings and create a whole new market outreach opportunity.

This paper shares the determined savings from the metering studies in this application. Each study is dissected, looking at the methodology, barriers, variances, and results of the study. The paper makes recommendations on how APS can be promoted for dorm rooms, and justifies the extent to which this application can be included in utilities' portfolios.

Introduction

Advanced power strips (APSs) are highly effective in home office and home entertainment applications. They cut power to peripheral devices when a control device is shut off. Although an APS looks like a typical surge protector, the basic APS features three different types of outlet options: *always on*, *control*, and *switched*. In an audio-visual setting, a television could be used as the *control* device, and when the user shuts it off, the peripheral devices that are plugged into the *switched* outlets turn off instantaneously. A typical peripheral device might be a DVD player, game console, or an audio / speaker system. An APS can cut power to the peripheral devices without user involvement, thus avoiding the potential for plug load that consumer electronics can draw when left on or even when in *off* or *sleep* modes. The *always on* outlets maintain constant power, despite the control strategies for the other controlled or switched outlets. Cable boxes and chargers are frequently plugged into these outlets because they need electricity, regardless of the power status of the other connected devices.

Vermont's statewide energy efficiency utility, Efficiency Vermont, conducted several APS studies at the University of Vermont (UVM) to measure the extent of possible energy savings among college students living in dormitories. The following studies indicate the results.

First Study: Redstone Lofts

Methodology

Efficiency Vermont carried out the first APS study at UVM in the Redstone Lofts (RSL) apartment housing for upperclassmen. Before installing the meters, Efficiency Vermont chose the leased RSL apartments to increase the likelihood that there would be students living in the rooms throughout the four-week period. RSL leases start in June and continue for a full year. The typical devices of a year-round student and long-term residency made for a valid test group.

The researchers obtained a computer-generated list of students, and categorized them according to the apartments' six possible room types: studio, 1-bedroom, 1-bedroom with 2 beds, 2-bedroom (2 students), 2-bedroom with 2 beds (4 students), 3-bedroom, and 4-bedroom. It is important to note that when the occupants of the randomly selected rooms were contacted about participating, none of them had the expected number of students living in them for the summer. The impact was a decreased the number of participants and potentially their connected loads. Nevertheless, students were screened and enrolled according to study protocols, and the number of participants per room was carefully recorded.

The study began July 2, 2013, with the installation of WattsUp? Pro electricity meters in seven different student apartments. The meters monitored electricity use for four weeks, the first two with a traditional surge protector and the second two with an APS.

Screening

In-person screening determined that (1) students were already using a standard surge protector somewhere in their apartments, (2) at least one person would be living there for the duration of the study, and (3) there was a relatively even distribution of people for each room type (that is, the study determined that there was no instance in which only 1 person was living alone in a 4-bedroom apartment). Every eligible student who met the screening criteria agreed to participate. No room had four occupants.

Installation Protocols

The occupants of seven rooms participated in the study. Each was given information about important meter installation dates, facts about plug load, FAQs about the study, Efficiency Vermont contact information, and diagrams and instructions regarding how to correctly use the APS. Each was allowed to keep the APS unit at the end of the study.

Study staff assigned numbers to each meter so that the downloaded data from the study could be matched to the corresponding room and occupant(s). The meters plugged into a standard wall outlet and each surge protector or APS was plugged into the meter's socket. Participants understood that unplugging the black meter from the wall would affect the data, a warning reinforced by notes on each meter warning occupants not to "unplug meter from wall!" The meters measured power in watts every 5 minutes for the full four weeks.

The original intention was to install and record data for an exact two-week period. That is, the study team always attempted to install the meter at the exact time of day when the APS would be switched. For example, if Meter 2 was installed at 2:30 pm on July 2 for the beginning of the baseline data capture period, switching out the existing surge protector with the APS was planned for 2:30 pm on July 16. Switching out the APS and the meter was then planned for 2:30

pm on July 30, the end of the APS data capture period. This protocol could not reliably be followed, because of variances in student schedules. However, some of the time periods varied by only a few minutes; in other cases, meters had to be installed days or hours ahead or behind the intended time. In the majority of cases, the meters were installed between 2:30 pm and 4:30 pm on July 2; the surge protectors were switched out for APS units between 2:30 pm and 4:30 pm on July 16; and the meters were uninstalled (and monitoring stopped) between 2:30 pm and 4:30 pm on July 30.

Data Calculation

Data were calculated with two different methods. Method A calculated savings from the time periods when all devices were turned off and still drawing standby power with the surge protector in place, compared with energy use when all devices were turned off with the APS in place. When a peripheral is left on but is not in use, it still consumes energy (plug load) when plugged into a traditional surge protector. For example, an audio speaker could be powered on but not playing music. The APS's main purpose is to target such situations and shut off this forgotten speaker when the user shuts off the control device. During the two weeks in which the APS was in place, study staff hypothesized that there would be more instances in which all peripherals were not drawing power, compared to the two weeks with a regular surge protector.

The shortcoming of looking at power use with a surge protector in place and using Method A is that it is impossible to know whether the devices are actually in use or just left on. That is, the study was looking at the times in which the devices were all off. The main advantage of using Method A is that it shows the minimum amount of savings that can be realized, the savings associated with the *everything off* condition. Although this approach illuminates the phantom load reduction savings, the disadvantage is that it doesn't include the larger savings associated with turning off appliances that were accidentally left on.

Method B calculated savings by taking the average use of each two-week span. This compared the average energy use of the baseline two weeks to the average energy use of the second two weeks with the APS installed. However, this method might not account for random changes in behavior that might occur if, for example, the participant happened to watch more television during the baseline period. Nevertheless, this number gives a broader picture of the potential for energy savings compared to Method A.

Results

Table 1 shows the savings of the seven participant rooms. They ranged from an annual loss of 3.9 kWh to positive savings of 60.0 kWh using Method A. For Method B, annual savings ranged from a loss of 595.4 kWh to positive savings of 227.4 kWh. The loss of 595.4 kWh appears to be an outlier in this data set and may be a result of undocumented changes in behavior or additions to plug load.

The devices connected to the APS seemed to be the most reliable indicator of savings. The low or negative kWh savings with the APS could often be explained by incorrect use of the APS unit. In Participant 1's studio apartment, the APS was not being used properly with a control and corresponding peripherals. Instead, this participant used it as if it were a surge protector or plain socket, with devices that are most commonly plugged into the *always on* outlets when they are being used. Since a control device did not shut off the plug load of these items, no savings could accrue. Similarly, Participant 7 had only one peripheral in addition to the *always on* devices of a desk lamp and phone charger. Her computer tower served as a control and her computer monitor was a peripheral. This participant saw only 0.7 kWh to 10.5 kWh in annual savings, depending on which calculation method was used. Despite the fact that the participants did not optimally use the APS, these participants do represent an important group of potential APS users: those who use the unit as a regular socket with electronics that they plug into *always on* sockets.

Table 1. Participant information and associated energy savings

Characteristics of study sample				Method A		Method B	
Participant number	Room type	Number of tenants	Devices used	Annual kWh savings	Annual cost savings	Annual kWh savings	Annual cost savings
1	Studio	1	Laptop charger, phone charger, lamp	-3.9	-$0.55	-39.5	-$5.53
2	1 bedroom	1	TV as control, Wii, cable box, Blu-ray	61.9	$8.66	-15.3	-$2.14
3	1 bedroom (2 beds)	2	Audio receiver as control, projector, PS3	3.7	$0.52	127.2	$17.81
4	2 bedroom	2	One speaker as control, multiple other speakers, keyboard, laptop charger, computer monitor	-2.3	-$0.32	-595.4	-$83.35
5	3 bedroom	3	TV as control, audio receiver, N64, cable box, PS3	36.5	$5.12	227.4	$31.84
6	4 bedroom	3	TV as control, VCR, cable box	60.0	$8.39	30.4	$4.26
7	4 bedroom	2	Computer as control, desk lamp, computer monitor, phone charger	0.7	$0.10	10.5	$1.46

*Savings calculated with a conservative average price of electricity of $0.14 / kWh.

The combination of devices Participant 4 used, along with metering issues, made it an interesting data point. This participant unplugged the meter midway through the study; study staff spotted different devices during the third and fourth visit to the apartment. Further, the audio speaker used as a control was recognizable only with the APS's adjustable threshold turned to *low*. The APS needs to sense the current of a device to be able to shut it off. Usually, with TV and PC applications, this threshold is on *high* and does not need to be adjusted because these devices easily step over the 40 watts necessary to trigger the APS current-sensing. However, the large speakers in this case stepped over the lowest setting of 10 watts. This was surprising to study staff, since they were large, professional-grade speakers that the occupants used to mix music. Regardless, this apartment used a lot of energy and did not realize much in savings when using the APS. Although it looks like an outlier, the occupants' energy use has offered valuable data. If the APS is to achieve market saturation, or even market success, users like Participant 4 are bound to buy them and see inconsistency in the APS's claims of savings. With all of these empirical examples, it has become apparent that the APS is useful in some applications, but not necessarily in others.

The APS performed best in apartments in which it was being used in home entertainment conditions with multiple peripherals. For Participant 2, using the TV as a control and Wii, cable, and a Blu-ray player as peripherals, annual savings were 61.9 kWh using Method A. Method B showed a loss. In Participant 3's setting with audio as a control, and a projector and PS3 as peripherals, the annual savings were 3.7 kWh under Method A and 127.2 kWh under Method B. Participant 5, a 3-bedroom apartment, used a TV as a control and an audio receiver, N64, cable, and PS3 ran as peripherals. Annual savings amounted to 36.5 kWh with Method A, and 227.4 kWh with Method B.

Although this range of savings is large, offering appropriate incentives and competitive pricing of APSs could allow them have a shorter payback period, perhaps a year or two if they are used in settings similar to the 3-bedroom conditions shown here. Of course, APSs are supposed to reduce plug load. Participant 5 is an excellent example of the potential for remediating the wasted energy from home entertainment's massive plug load, since so many relevant peripherals are involved.

Second Study: UVM Dorm Study

Methodology

After the results of the first study, Efficiency Vermont staff expanded the participation base to understand APS savings in a typical dorm setting. Staff conducted another study in Fall 2013 on the University of Vermont campus. Most rooms were located on Central Campus in older dormitory buildings that are in close proximity to academic buildings. Six different dorm buildings across the campus were actually used in the study. This study involved a partnership with UVM's student Eco-Reps program, which fosters environmental responsibility in residence halls. Six Eco-Reps helped Efficiency Vermont study staff to recruit participants, install and uninstall meters and APSs, and record data.

For this study, study staff gave participants information on important meter installation dates, facts about plug load, FAQs about the study, Efficiency Vermont contact information, and diagrams and instructions regarding how to use the APS. Staff applied training in both studies, but they emphasized it more in the second. Eco-Reps needed training and Efficiency Vermont hoped to offer students as much success as possible with their APSs. Eco-Reps learned about Efficiency Vermont's mission, and about plug load, recruitment techniques, and study protocols such as how to install or record information from meters. Additionally, the Eco-Reps and study staff brought information materials to the students' rooms. A student information sheet gave essential contact information, study schedule, a summary of the student's role in the study, and a list of frequently asked questions about APSs and Efficiency Vermont, as shown in Figure 1.

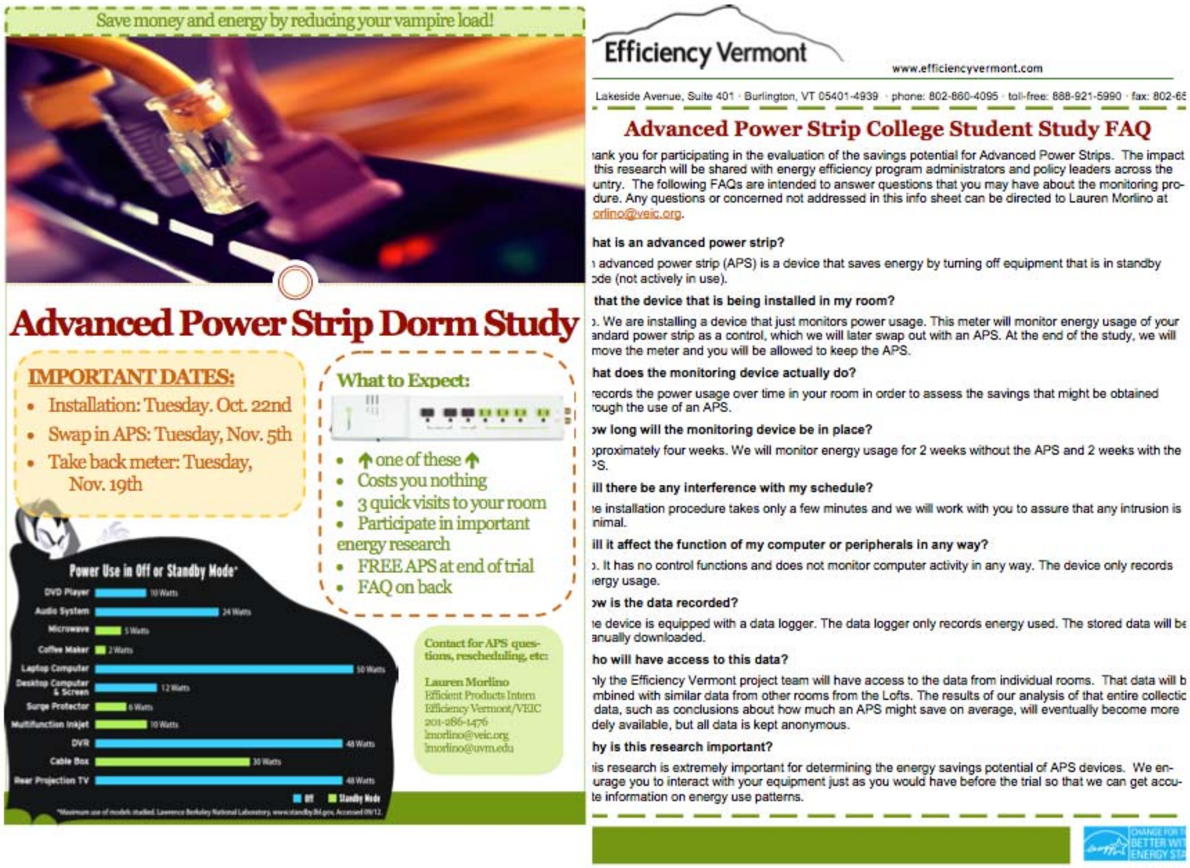

Figure 1. Student information sheet provided to participating UVM students.

Another information sheet for participants described how to use their APSs. It pictured the exact APS model used in the study, provided steps for choosing the correct peripherals, messaging about not unplugging the meter, manufacturer diagrams, and a list of appropriate peripherals, all shown in Figure 2.

In addition, a post-study survey was conducted to further understand study results. Students were asked a series of questions regarding their experience with the APS.

Screening

Similar to the Redstone Lofts study, this study screened the participating dorm room occupants. Since Eco-Reps' advocacy is rooted in UVM's residence halls, they were able to knock on doors to obtain permission to participate, thus making for random sampling. Students that live in UVM's environmentally-conscious learning community were not permitted to participate, their "green" attitudes potentially skewing the results. Two of the pre-screening criteria from the RSL study were repeated: (1) students were already using a standard surge protector somewhere in their dormitory; (2) students would be living there for the next 4 weeks. However, this time around participants were recruited based on whether or not they had the correct peripherals for the study. For instance, ideally, students with a television or desktop computer with corresponding peripherals were offered participation. However, this was not always the case, as many students started with correct set ups and eventually ended the study with different peripherals plugged into the APS. Obtaining fifty or more participants was the goal, however, for numerous reasons discussed later, twenty-two ended up in the sample.

Figure 2. Information sheet for participants.

Installation Procedure

Study staff visited participants four times in this study: October 15 for recruitment; October 22 for installation of meter with regular surge protector; November 5 to switch to APS; and November 18 for meter retrieval. In a few cases, staff retrieved meters a day later than anticipated; this difference was normalized in savings calculations. Fourteen WattsUp? Pro and WattsUp? Pro ES meters capable of data logging were used, programmed to take 5-minute interval data for the duration of the study. Eight other participants were equipped with simpler WattsUp? meters, which required manual recording of kWh. When the meters were installed, study staff stressed that the meter stay plugged into the wall and peripherals remain essentially as plugged in at the outset. Staff conducted a post-study survey on the final visit to verify this when they retrieved the meter.

Data Calculation

Study staff applied two different methods (one for each type of meter) to determine the extent of decreased energy use associated with APSs. For APS installations that were monitored with interval logging WattsUp? Pro and WattsUp? Pro ES meters, which measured power use in five minute intervals. The interval data points were not normally distributed, so staff used a bootstrap re-sampling statistical procedure to determine the average decrease in wattage that could be ascribed to the APS, with 90% confidence intervals. The APS installations that used the basic WattsUp? meters required manual readings in kWh used over the trial period because they did not record interval data. For these set-ups, staff calculated the difference in the average daily kWh use between pre-APS installation and post-APS installation.

Staff hypothesized that the magnitude of savings from the APS would be related to both the wattage of the peripherals controlled by the master device and the use of those peripherals relative to the master device. To gain insight into the relationship between savings and the quality of the APS installation, staff reviewed the type of equipment plugged into the APS sockets. Staff determined which installations were *optimal*, *poor*, or *not applicable*, depending on whether the use of the load plugged into the switched sockets could reasonably be assumed to be exclusively associated with the use of the master device. For example, a television master appliance with an Xbox-switched appliance would be considered an optimal installation. The wattages of the devices plugged into the control and switched outlets were determined via typical appliance wattages where possible.

For interval meters, the expected annual savings was calculated as the change in average wattage (pre- vs. post-APS installation), multiplied by 8,760 (hours in a year) and by 5,376 hours (or 32 weeks, the length of a school year), converted to kilowatt-hours.

Results

Table 2 shows the savings of the 17 participant rooms; they ranged from an annual loss of 136.5 kWh to positive savings of 349.3 kWh. The savings ranged from a loss of 83.8 kWh to positive savings of 214.4 kWh when calculated just for the school year. In many cases, the low or negative savings were connected with APS installations that were not optimal (Participants 7, 9, and 16). The highest savings were seen for participants with both an optimal set up and with a high number of devices (and wattage) in the switched outlets (Participants 2, 14, and 17). As shown in Figure 3, the relationship between the magnitudes of the switched load for installations that were deemed *optimal* was found to be significantly related to the overall magnitude of savings.

Of the 17 set-ups, 6 (35%) either were a *poor* set-up or the user unplugged devices during the study. Table 3 and Table 4 show that the average annual or school year kWh savings is always higher when considering only the optimal installations. Average savings considerably decrease or become negative when *poor* or *not applicable* set-ups are considered.

Table 2. Participant information and associated savings, UVM APS Dorm Study

Partici-pant number	Meter type	Devices used (control and switched outlets)	Set-up type	School year kWh savings	School year cost* savings	Annual kWh savings	Annual cost savings
1	Interval	TV as control; Xbox	Optimal	104.8	$14.76	170.7	$23.90
2	Interval	Desktop computer as control; monitor, speakers, PS 3	Optimal	133.6	$18.71	217.7	$30.48
3	Interval	TV as control; DVD player	Optimal	-0.6	-$0.08	-0.9	-$0.13
4	Interval	Monitor as control; printer, Xbox, speakers	Optimal	63.1	$8.83	102.8	$14.39
5	Interval	TV as control; lamp, laptop charger	Poor	22.6	$3.17	36.9	$5.16
6	Interval	TV as control; speakers	Optimal	-60.5	-$8.47	-98.5	-$13.80
7	Interval	TV as control; phone charger, Gameboy	Poor	-83.8	-$11.73	-136.5	-$19.11
8	Interval	TV as control; Xbox, alarm clock	N/A	50.8	$7.11	82.7	$11.58
9	Interval	TV as control; speakers, lamp	Poor	4.1	$0.57	6.6	$0.93
10	Interval	TV as control; Wii, Nintendo 64, Roku box	Optimal	17.1	$2.40	27.9	$3.91
11	Interval	TV as control; pencil sharpener, printer, Xbox	Optimal	22.4	$3.14	36.5	$5.11
12	Interval	TV as control; PS 3	Optimal	-2.8	-$0.40	-4.6	-$0.64
13	Manual	TV as control (swapped to Xbox); Xbox (swapped to TV), black light, lamp, calculator charger	N/A	41.4	$5.80	67.5	$9.45
14	Manual	Monitor as control; laptop charger, Xbox, external hard drive, lamp	Optimal	185.9	$26.03	303.0	$42.41
15	Manual	TV as control; laptop charger, Game Cube	Optimal	-22.6	-$3.17	-36.9	-$5.16
16	Manual	TV as control; speakers, Playstation, lamp, charger (unplugged)	N/A	18.4	$2.57	29.9	$4.19
17	Manual	TV as control; Xbox, printer, microwave	Optimal	214.4	$30.01	349.3	$48.90

*School year savings were calculated based on a 32 week school year.

Table 3. Average annual kWh savings

Set-up	Interval meters (kWh)	Manual meters (kWh)	Both types of meter (kWh)
Optimal set-ups only	34.6	125.9	59.5
Poor or N/A set-ups only	-1.6	29.9	8.9
All set-ups	22.6	87.5	41.7

Table 4. Average school year (32 weeks) kWh savings

Set-up	Interval meters (kWh)	Manual meters (kWh)	Both types of meter (kWh)
Optimal set-ups only	56.5	205.1	97.0
Poor or N/A set-ups only	-2.6	48.7	14.5
All set-ups	36.8	142.6	67.9

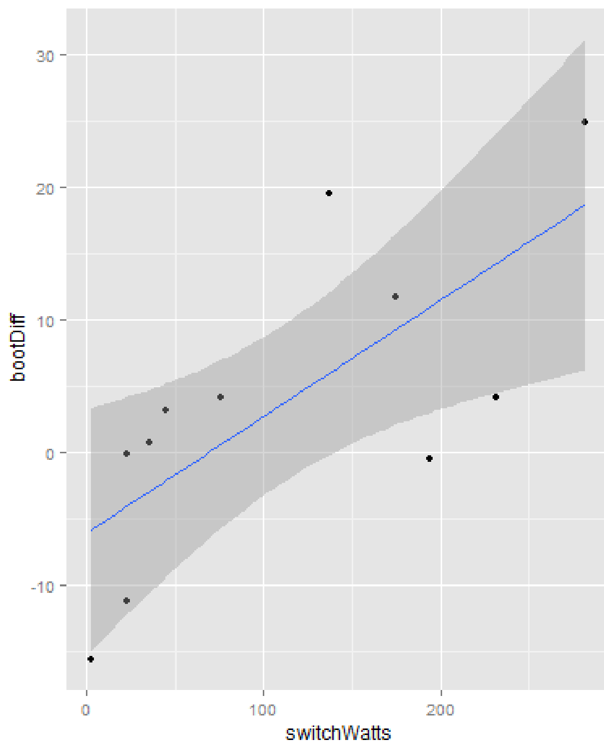

Figure. 3 bootDiff = savings wattage (between pre and post) vs. estimated switched watts, *optimal* setups only. Dark grey box is 90% confidence interval.

Barriers and Lessons Learned

Many of the lessons learned from the APS metering studies could be referenced for inclusion of APS in utility programs. Lack of knowledge of product and plug load were noticeable barriers, attributed to the fact that vampire plug load is a relatively abstract idea for most consumers. A post-study survey was conducted in which the students were asked a series of questions regarding their experience with the APS. All questions were answered on a scale of 1 (definitely not) to 5 (absolutely). One question read, "Did you find the APS confusing to use/understand?" The average score for this question was 2.1, indicating that the participants really did not have trouble understanding how to use the APS when given proper instruction. However, this only takes into account one participant out of each room and most likely the one that was the contact person for the study and therefore had the most knowledge of the product. It is also important to note that one of the participants indicated that it was 3.5 of 5 on the confusion scale. Although a bigger sample size would be ideal, this participant could be an indication of a few consumers who would be confused about how the APS works, even with adequate education. Anecdotally, the average consumer is more likely to stumble across an APS in the store and buy it instead of making an informed purchase. In that case, the consumer would get most of their information from the packaging of the APS, which does not come with an Efficiency Vermont employee to install and provide support for the device.

Students also indicated that the device did tend to interfere with certain peripherals. One participant explained that the projector he uses in place of a television monitor usually runs a cool down cycle after it is turned off. Since the APS cuts the power to the *switched* outlets immediately, the projector was stopped from running this cycle as it normally does with a manual turn off. If the projector is designed to cool itself down after use, this abrupt stop to the cycle could be detrimental to the device in the long-term. Other students reported that game consoles, when turned off by the APS, were not allowed to do routine automatic updates. Both of these scenarios are extremely important to take into consideration when understanding what devices would work best with an APS. The consumer would not want the use of the APS to negatively affect their other consumer electronics.

Despite the fact that the studies were conducted solely in dorm rooms, they tested the behavior and energy usage of many different students in many different situations. Students often switched the peripherals, either from rearranging their dorm rooms or needing as many outlets as possible. Dorm rooms are also extremely small, 154-157 square feet[5], which means that a printer and a microwave, two things that would normally rarely be next to each other in a home setting could easily be two peripheral devices plugged into the same APS. Many of the students only had laptops for school instead of desktop computers, so *always on* sockets were in high demand as most of them had at least two chargers: mobile and laptop. Since televisions are a good *control* device for using an APS, students were asked almost immediately in the pre-screening if they owned a television. However, UVM had recently stopped the supply of cable to dorm rooms so students had been advised not to bring televisions. Since online streaming has become so popular, many students said they either watch TV on their laptops or they hook their laptop up to the TV using an HDMI cord and had no additional peripherals. This, of course, is not an ideal APS setup. Students in the dorms also do not pay for their own electricity causing them to be more apathetic about their energy usage than the average APS buyer.

Conclusions

Education about both plug load and advanced power strips is essential in order for utility programs to implement a successful APS program. It is important for consumers to understand how much energy they could avoid wasting in their home, and of course, the money associated. How might education of plug load and APS be achieved? Without a national authority that certifies or promotes APS like EPA's ENERGY STAR®, manufacturers, retailers, and utilities need to take on the responsibility of educating consumers themselves. Schools also have the opportunity to start teaching energy efficiency to students, making them more aware of their energy use before they are responsible for paying their own bill.

Education also leads to more savings. In the first RSL Study, the students who used the APS units in its intended settings, specifically home entertainment setups with many peripherals, were most likely to see savings. In fact, on average these settings boasted savings of 92.4 kWh annually. Using a conservative average price of electricity in Vermont of $0.14/kWh, this translates to annual savings of about $12.94. The second APS study showed similar results, with the *optimal* setups seeing higher average kWh savings than the *poor* and *not applicable* setups. With APS prices consistently dropping, incentives consistently rising, and becoming more widespread, this means that the unit could pay for itself in its first or second year of use.

On the other hand, participants that were using the APS in *poor* applications versus *optimal* applications were not likely to as much savings. The studies were designed to be a side-by-side comparison of the energy usage of devices in a regular power strip versus in an APS. However, an immediate switch to APS may not be the best option in all cases. Perhaps every power strip in a dorm should not be replaced with an APS, but they certainly can be applicable for use with a network of high-powered devices like we see in home entertainment (and possibly home office) settings. The APS tended to be relatively user-friendly with one students summarizing that he liked using the APS after overcoming the "steep learning curve". Issues of complexity, knowledge, and peripheral interference were rectifiable. The students may not be likely to go out and buy an APS on their own though. Not many of the participants said they would "absolutely" buy one, but since they were given an APS for the study, they did not mind using it. This is important to keep in mind when considering the target market for APS.

Given the results of this study, with proper education and direct installation, the use of APS can yield savings in dorms. There is a steep learning curve with the devices and users often become overwhelmed at the sight of complex packaging, messaging, and instructions. With dormitory settings introducing a whole new group of obstacles, it is important to stress that savings will be realized only if information is clear, visible, and emphasizes correct application of the product.

References

Earle, L., and B. Sparn. "Results of Laboratory Testing of Advanced Power Strips." U.S. Department of Energy: Energy Efficiency and Renewable Energy. apps1.eere.energy.gov/buildings/publications/pdfs/building_america/advanced_power_strips.pdf (accessed June 4, 2013).

Urban, B. V. Tiefenbeck, and K. Roth. "Energy Consumption of Consumer Electronics in U.S. Homes in 2010." Consumer Electronics Association. www.ce.org/CorporateSite/media/Government-Media/Green/Energy-Consumption-of-CE-in-U-S-Homes-in-2010.pdf (accessed June 21, 2013).