Idle Load: Reducing Energy Wasted by Non-Active Devices

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INTRODUCTION

Energy conservation and sustainable energy practices are gaining more attention and becoming ever more important as issues relating to climate change and need for sustainability become more apparent. The residential sector consumes 20% of the total energy consumed in the United States (Weiner, 2019), so if everyone is able to make small changes, that can lead to a decrease in overall residential energy use and decrease costs. Appliances use more energy than people often realize -- increasing bills and wasting valuable energy. On a small scale, this case study examines how effective un-plugging appliances can be. The two bedrooms studied are within apartments in Eugene, Oregon, close to the University of Oregon campus. The purpose is to determine whether unplugging the appliances will show a significant reduction in energy usage, therefore also lowering energy costs for the tenant.

RESEARCH QUESTIONS & HYPOTHESIS

How much energy can be conserved by actively unplugging devices?
How much money will this save tenants on their energy bill?

The end goal of this research is to determine whether habits of actively unplugging appliances will show a significant reduction in energy usage to both conserve resources and reduce costs to tenants.

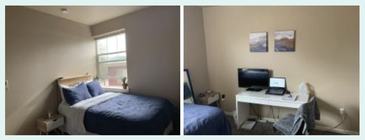
Hypothesis: Unplugging appliances while not in use will decrease energy usage and energy bills by at least 25%.

METHODOLOGY

In this study the measuring device used collects data on the amount of watts appliances are using while plugged in, and KWh over time. Below is a picture of the device: a digital power analyzing monitor that plugs into the wall outlet. There were 2 day long tests in each bedroom. In the first test all appliances will be left plugged in for an entire day and in the second test the appliances will be unplugged when not in use. By knowing the active and idle energy use of each appliance, it can then be calculated how much energy is used in the day based on the amount of time each appliance is plugged in and in use using the formula (E(kWh) = P(W) × t(hr) / 1000) where the the energy E is equal to power P multiplied by hours of use t divided by 1000 to convert to kWh. This gave an accurate reading of how much energy was saved, as well as the amount of money saved.

Digital Power Monitor Meter Usage Energy Watt Amp Volt KWh Electricity, manufactured by Zhengzhou Paiji Technology

Bedroom #1



Bedroom #2

DATA

Bedroom #1 Appliance Measurements

Energy Use (Watts)	iPhone Charger	Macbook Charger	Bedside Lamp (Old)	Spotlight Desk Lamp	Makeup Mirror Lamp	Computer Monitor with Surge Protector
Active	6.5 W	39 W	3.6 W	2.8 W	30.4 W	23.8 W
Idle	0.5 W	2 W	0.5 W	0.34 W	1.7 W	3 W

Bedroom #1 Data

Day 1 - All appliances are plugged in 24/7

Day 2 - Appliances are only plugged in for active use

Appliance Use (Hours)	iPhone Charger	Macbook Charger	Bedside Lamp (Old)	Spotlight Desk Lamp	Makeup Mirror Lamp	Computer Monitor with Surge Protector
Day 1 Active	9 Hours	5 Hours	1 Hour	4.5 Hours	0.33 Hours	6.5 Hours
Day 1 Idle	15 Hours	19 Hours	23 Hours	19.5 Hours	23.66 Hours	17.5 Hours
Day 2 Active	8.5 Hours	6.2 Hours	3 Hours	3.7 Hours	0.40 Hours	6.1 Hours

Energy Use (kWh)	iPhone Charger	Macbook Charger	Bedside Lamp (Old)	Spotlight Desk Lamp	Makeup Mirror Lamp	Computer Monitor with Surge Protector	Total
Day 1 Active	0.0585 kWh	0.195 kWh	0.0036 kWh	0.0126 kWh	0.010032k Wh	0.1547 kWh	0.434432 kWh
Day 1 Idle	0.0075 kWh	0.038 kWh	0.0115 kWh	0.00663 kWh	0.040222 kWh	0.14518 kWh	0.249032 kWh
Day 2 Active	0.05525 kWh	0.2418 kWh	0.0108 kWh	0.01036 kWh	0.01216 kWh	0.14518 kWh	0.47555 kWh

For a 24-hour period, the total energy usage on Day 1 in Bedroom #1 was 0.683464 kWh. The total energy use on Day 2 in Bedroom #1 was 0.47555 kWh. This shows a 30.4% reduction in energy use from Day 1 to Day 2.

ANALYSIS

Findings from the case study showed that by doing so it was possible to reduce energy consumption by over 30%. Bedroom #1 used more energy in total than Bedroom #2; however, the energy reduction was proportional to total energy use.

Cost Analysis

Electrical residential pricing in Eugene from the Eugene Water Electric Board is as follows:

Fixed base cost: $20.50 / month
Delivery charge: 2.62 cents / kWh = $0.0262
Energy charge: 6.52 cents / kWh = $0.0652

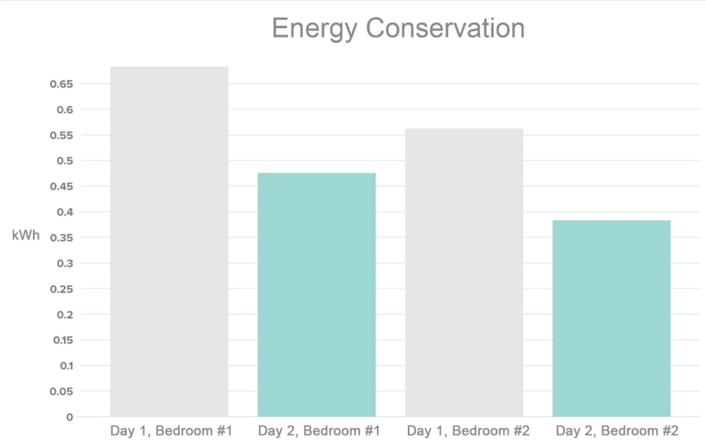
Bedroom #1

If every appliance remained plugged in for one month, the electric bill for the bedroom would be $1.874. If the methodology of unplugging unused appliances was followed for a month, the electric bill for the bedroom would be $1.303

Bedroom #2

If every appliance remained plugged in for one month, the electric bill for the bedroom would be $1.542. If the methodology of unplugging unused appliances was followed for a month, the electric bill for the bedroom would be $1.051

Overall: The cost, like energy, was reduced by 30.4% in Bedroom #1 and 31.8% in Bedroom #2.



DATA

Bedroom #2 Appliance Measurements

Energy Use (Watts)	Iphone Charger	HP Laptop Charger	Echo Dot	Polaroid Television	Desk Lamp
Active	6.3 W	48 W	5.2 W	22.9 W	3.2 W
Idle	.5 W	4 W	.4 W	2.6 W	.43 W

Bedroom #2 Data

Day 1 - All appliances are plugged in 24/7

Day 2 - Appliance are only plugged in for active use

Appliance Use	Iphone Charger	HP Laptop Charger	Echo Dot	Polaroid Television	Desk Lamp
Day 1 Active	10 Hours	6 Hours	5 Hours	1 Hour	2 Hours
Day 1 Idle	14 Hours	18 Hours	19 Hours	23 Hours	22 Hours
Day 2 Active	9 Hours	5 Hours	6 Hours	2 Hours	3 Hours

Energy Use (kWh)	Iphone Charger	HP Laptop Charger	Echo Dot	Polaroid Television	Desk Lamp	Total
Day 1 Active	.063 kWh	.288 kWh	.026 kWh	.0229 kWh	.0064 kWh	.4063 kWh
Day 1 Idle	.007 kWh	.072 kWh	.0076 kWh	.0598 kWh	.00964 kWh	.15604 kWh
Day 2 Active	.0567 kWh	.24 kWh	.0312 kWh	.0458 kWh	.0096 kWh	.3833 kWh

For a 24-hour period, the total energy usage on Day 1 in Bedroom #2 was 0.56234 kWh. The total energy use on Day 2 in Bedroom #2 was 0.3833 kWh. This shows a 31.8% reduction in energy use from Day 1 to Day 2.

CONCLUSION

The guiding purpose of this case study was to find a cost effective way to reduce energy use and cost. It is becoming more commonly known that devices in idle modes are continually wasting energy which could be conserved by unplugging the unused devices. According to new research (Natural Resources Defense Council (NRDC), 2015), on the topic of idle energy loads (as a much larger scale), showed that idle energy use in residences studies ranged from 20%-70% of annual use. This wasted energy cost Northern California residents from $210 to $440 annually. The study found that by unplugging devices in idle mode, the energy use could be reduced by about 30%, supporting the previous hypothesis that the energy reduction would be 25%. Further inquiry into the effectiveness of this energy-conservation technique could be studied on a larger scale. This study is at a very small scale, so the result of saving about 50 cents per month may not seem "worth it" for the effort of unplugged idle appliances; however, for an entire family home or office space, it can make a big difference in the electric bill.

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