Vampire Power

Introduction:

You probably know that electrical energy is required to operate an electrical appliance when you are using it. But is electrical energy still consumed even when you are not using it?

Consider the following scenarios:

- Families that are away for a holiday for a few months, not using their household appliances for that time.
- People not using their devices in the office or at work overnight .
- Leaving your mobile, iPad, or laptop charging throughout the night.

You might think that the electricity meter does not record any power usage during these times. However, in many cases the meter will still register some value. But how? Is somebody stealing your electricity? Let us investigate!

Many household appliances have features such as remote control, pre-set memory, clock display, instant on etc. All these features consume electrical energy. Some electrical transformers, located near the appliance's power switch, also consume electrical energy even when the appliance is switched off. Other appliances like computer modems or cordless phones which have to always be ready are always consuming some energy, even when they are not in active use. This type of power consumption is generally known as standby power, some other names include 'phantom load' and 'vampire power'. Many appliances such as computer monitors will enter a standby mode automatically after a pre-set amount of time. The standby energy loss of a single appliance might seem insignificant in comparison to the electricity consumption of an entire household, but these losses add up to hundreds of kilowatt hours per household per year.

Equipment:

a) ***Suggested electrical appliances*:** You don't have to use all of these and you can try different ones if you like.

Computer (desktop)	Computer (Laptop)	Computer monitor
Answering machine	Desktop sound speakers	Mobile phone with charger
Refrigerator	Printer (inkjet, laser)	CD player
Microwave	Sandwich maker	Toaster
Electric toothbrush with charger	Halogen Lamp	Clock Radio
Hair dryer	Electric Razor with charger	CFL Lamp

b) ***Instrument used for measurement***:

Power meter:

The power meter shown below is a Power Tech Plus Multifunction Energy Meter. This is an affordable power meter that can accurately measure instantaneous power. However, most brands of store bought plug in power meters will be suitable for this investigation.

CAUTION: Do not plug in appliance that draws more current than the meter is rated for.

Aim: To accurately measure the standby power used by a variety of household appliances, and estimate the yearly cost of this wasted power. Experiment with ways of reducing standby power for as many devices as possible.

Method:

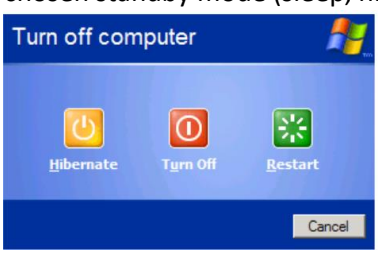
1. For each of the appliances you will be using in your investigation, estimate the number of hours of usage on an average day.

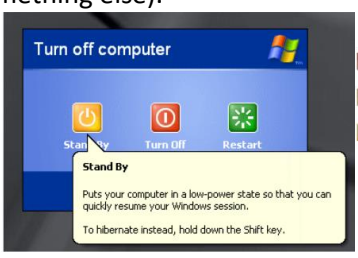
Table 1: Operating Hours:

Appliance	Assumed Daily Operated Hours	
	In Use	Standby Mode

1. Select the first appliance you are going to test.
2. Plug the appliance into the power meter and then plug the power meter into the wall socket and switch it on.
3. Set the power meter to 'Watt'. This will be the default function of most power meters.
4. Record the power that is being used while the device is in use and in standby mode.

Make notes about how the appliance is being used, and what standby mode is being used. For example if you are using a laptop computer you may want to record what the current battery status is, what the computer is doing when in use, (word processor, playing video or games), what is the standby mode chosen standby mode (sleep, hibernate, something else).





Also make a note about the qualitative heat condition like warm, room temperature or hotness of the appliance. Repeat the above steps for all other appliances and note down the readings in the following table.

Table 2: Operating and Standby Power for any electrical appliance and its heat conditions:

Appliance	Operation Mode	Power	Heat Conditions	Notes
	In Use			
	Standby			
	In Use			
	Standby			
	In Use			
	Standby			
	In Use			
	Standby			

Fun fact!

Even something as simple as household lighting has improved a lot over the past 100 years. Shown here are major steps in development. The first improvement over the humble candle was the standard incandescent bulb, which is 50 times more efficient. This was replaced with another type of incandescent globe called a halogen lamp, which is about 90 times more efficient than the candle. The compact fluorescent (CFL) is about 250 times more efficient than the candle. And finally, the latest development is the LED bulb. Current LEDs have a similar efficiency to CFLs. However, they are much more environmentally friendly, and can theoretically bemade up to 1000 times as efficient as the candle

Analysis:

The Watt or kW is the unit for measuring power, 1 kWatt is 1000 Watts. The meter measures;

$Power = Electrical\ Energy / Time$

When it come to your electricity bill the electricity company doesn't charge you based on the power you are consuming at any given second but rather the total amount of electrical energy you use. This is typically measured in kWh. If we rearrange the previous formula, and use the power recorded in table 2 (remember to divide by 1000 to convert W to kW) and the time in use per day estimated in table 1, we can calculate the total energy used by the appliance over a year.

$$Energy = Power \times Time \times 365\ (days)$$

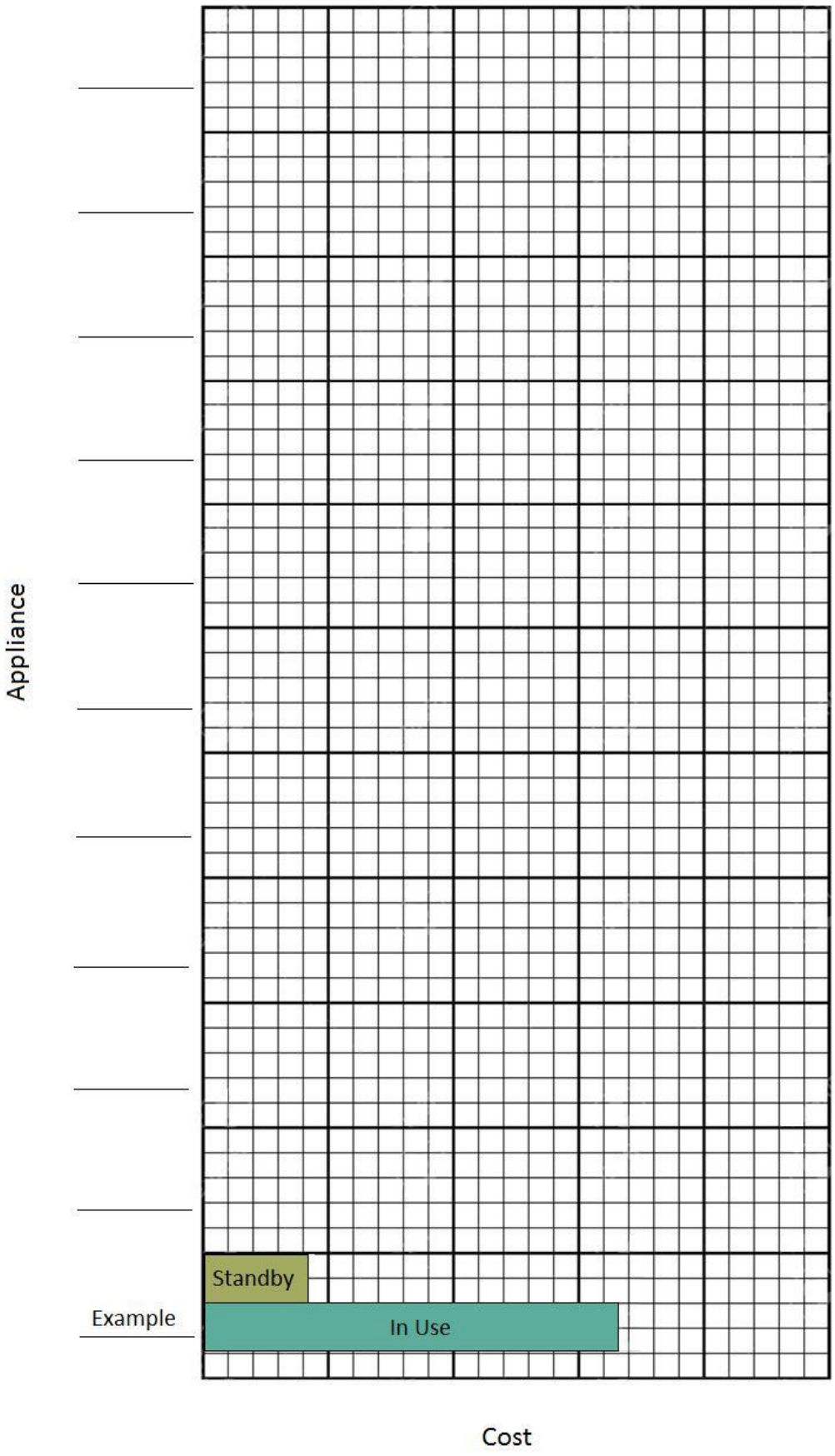
Record your results in the table below. A typical cost for electricity is 25 cents per kWh.

Table 3: Corresponding annual standby energy estimated for the measured electrical appliance

Appliance	Operation Mode	Energy (kWh)	**Yearly cost**
	In Use		
	Standby		
	In Use		
	Standby		
	In Use		
	Standby		
	In Use		
	Standby		
	In Use		
	Standby		

Graph your results on the next page

Cost of In-Use and Standyby
Power for Multiple Appliances



Discussion:

*Fill in the blanks choosing the **correct** word*

Standby Power is the electricity used by an appliance when it is _____ (a**ctive/idle**)
Appliances use more power when they are _____(**in use/on standby**)
Different types of electrical devices have different _____(**energy/power**) efficiency and use significantly different amounts of in use and standby_____ **(energy/power)**.

*Are the following statements **True** or **False**?*

The size of the screens does affect the power requirement	*True/False*
All types of electrical light globes (incandescent, halogen, CFL, LED) have the same energy efficiency	*True/False*
A considerable amount of energy could be saved by switching off devices rather than leaving them in standby mode	*True/False*
Energy efficiency and energy conservation are the same thing When	*True/False*
appliances and devices are in standby, they do not use power	*True/False*

Rewrite the following false statements to make them true

Electrical energy used is the same as power used

_____

_____

Leaking electricity can cause the meter to run and I will end up paying for electricity I did not use.

_____

_____

I leave all my appliances in standby – it is a great energy saver!

_____

_____

Conclusions:

This investigation has highlighted the importance of reducing the time that appliances are in _____mode as well as when they are in use. It was found that the _____ of having appliances in standby is not as much as when they are in_____ but it is significant. Consumer behaviour and choice of product (for example types of light globes) is important and different products have greatly varying _____ efficiency.

Image Credit

[1]Jiro Bevis: http://www.bloomberg.com/news/articles/2012-03-08/smart-meters-help-brazil-zap-electricity-theft
[2]https://www.jaycar.com.au/mains-power-meter/p/MS6115
[3]http://pngimg.com/img/objects/candle
[4]https://solutions.borderstates.com/new-lighting-technology-new-understanding-of-lighting-measurements-its-more-than-wattage/
[5]https://www.spreadshirt.co.uk/mode+long+sleeve+shirts