

A Study on Efficient Energy Use for Household Appliances in Malawi

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Abstract

Energy is important for the socio-economic development of all countries. However, the mismanagement of its utilisation can lead to a short fall in the supply of electricity. It is therefore imperative that everybody should be concerned about the efficient use of energy in order to reduce consumption. The demand for electricity in Malawi is so high that it is even more important to conserve and use efficiently the electricity available. Since households are one of the major consumers of electricity in Malawi, they should be involved in efficient energy use. The paper presents a study on the energy consumption of the most common household appliances in Malawi and prescribes the various steps that can lead to reduced energy consumption. The energy consumption of various household appliances has been measured over a period of one month in Zomba using a Landis +Gyr power meter. It was observed that the electrical-cooking stove, water heater, dry iron, and incandescent bulbs were the most electrical power-consuming appliances. It has also been observed that by using high-efficiency energy saving bulbs, households can reduce their electrical-consumption from ordinary incandescent bulbs by 90%.

Keywords: Efficient , energy use, household appliances, power consumption. power meter

Introduction

Malawi is a land locked country with a population of 14.8 million [2], of which 85% lives in the rural areas. This rural population almost extensively depend on firewood as a source of energy for cooking. The population is growing at a rate of 3.2 % each year [7]. With a land area of 94,000 square kilometres, Malawi is one of Sub-Saharan Africa's most densely populated countries. Biomass energy contributes over 95 % of its primary energy supply and over 88 % of national energy demand [1]

As a result, Malawi has had Southern Africa's highest deforestation rates, with forest reserves having declined in the past 25 years from 47% to 28% of the country's area, mainly due to the growing demand for wood fuel [7]. Although the hydro-electric power transmission lines extend the entire length of the country, and despite the fact that most villages are situated quite near the grid, access to electricity is only 7 % of the population [7]. This figure accounts for 20% of the urban population and only 1% of the rural population [1]. Those that have access to electricity often continue to use biomass for the purposes of cooking because of the prohibitive cost of electricity. With only 7% of the population connected to the grid, Malawi is one of the least electrified countries in the SADC region. The total installed capacity in Malawi grid is only 375 MW [5]. This will not be enough if access to electricity were to be increased. The World Bank reports that Malawi's power outages are the highest in Africa. This has been identified as a major constraint on Malawi's competitiveness and its ability to attract foreign investment.

Malawi is well endowed with environmental resources. However, degradation of these natural resources has been on the increase. It is being estimated that between 1990 and 2005 the country lost around 494,000

hectares of forest [1]. Environmental degradation is caused by inadequate alternative energy sources. In Malawi just like most developing countries, electricity supply is not adequate. Therefore, conservation of electricity would lead to increased access to the majority of its population. When electric power is conserved, it does not only increase access by a greater population, but also saves money.

2. Electricity measurement

Electricity makes our lives easier, but it can seem like a mysterious force. Measuring electricity is confusing because we cannot see it. Electricity is measured by a household electricity meter that shows how much electrical energy has been consumed in units called kilowatt hours (kWh). There are basically two kinds of electric meter categories, the electromechanical and solid state meters. Electromechanical meters operate by counting the revolutions of an aluminium disc which is made to rotate at a speed proportional to the power. The number of revolutions is thus proportional to the energy usage. It consumes a small amount of power, typically around 2 watts [4,6].

Solid state electric meters on the other hand display the power used on an LCD or LED screen. Apart from the amount of electricity used, the solid state electric meter type can also record other parameters of the load and supply such as maximum demand, power factor and reactive power used [3,8]. The technology used in most of the solid state electric meter type is the use of a current transformer to measure the current. This solid state meter, is the one that was used in the study.

3. Methodology

The method used was to measure the energy consumed by most common household appliances for varying periods and the results were converted into power consumption. This was done using the Landis +Gyr meter. Each of the household appliances was switched on while all others were off for varying periods in order to determine the power consumed. The electric cooking stove was first switched on for 1 hour to boil water with the plates on maximum settings while the griller was off. The process was then repeated when the plates were set on minimum. After this procedure, the griller was then switched on while the plates were off, and the energy consumed was recorded. Measurements were also done for the Geyser, Electric kettle, Microwave, Dry iron and Toaster and the results were recorded in Table 1. Energy consumption of the other appliances was also measured for 8 hour periods as shown in the table. The data was then analysed and recommendations were made on the best practices when managing power consumption for household appliances.

4. Results

The results presented in Table 1 below shows the power consumption of various household appliances as measured by the installed meter.

Table 1: Measured Energy and Calculated power consumption of selected household appliances using the Landis +Gyr meter

No	Type of Appliance	Energy measured in kWh	Period in Hours	Power consumption Calculated in Watts
1	Electric cooking stove : Stove Element (Max) (Min) (Creda UK) : Griller	1.50	1.0	1500 W
		0.15	1.0	150 W
		2.20	1.0	2200 W
2	Hot water heater (Geyser)	2.00	1.0	2000 W
3	Electric Kettle (Eco)	0.60	0.5	1200W
4	Microwave (Essentials); Stand-by : Running	0.001	0.2	10 W
		0.17	0.2	1000 W
5	Dry Iron (Philips)	0.50	0.5	1000 W
6	Sandwich Toaster (Mellerware)	0.45	0.5	900 W
7	Fridge (Kelvinator) :Everything off :Fridge light ON :Cooler ON	0.02	8.0	2 W
		0.24	8.0	30 W
		4.00	8.0	500 W
8	21" CRT Colour TV (Orion)	0.56	8.0	70W
9	Desktop Computer (Compaq): Off ; Memory test Windows (Idle) Watching DVD	0.05	8.0	6 W
		1.00	8.0	124 W
		0.62	8.0	78 W
		0.78	8.0	98 W
10	CRT Computer display: Stand by (Computer off) ON mode	0.02	8.0	2 W
		0.80	8.0	100 W
11	Standard Incandescent light bulb: × 8	6.40	8.0	800 W
12	CFL bulbs. × 8	0.96	8.0	120 W
13	Radio 3 CD changer (Philips), On,typical listening Standby	0.40	8.0	50 W
		0.04	8.0	5 W
14	DVD Player (Philips) : Standby : ON	0.01	8.0	1 W
		0.08	8.0	10 W
15	Digital Satelite Decoder :Standby (Phili bao) :ON	0.01	8.0	1 W
		0.08	8.0	10 W
16	Table Fan (Panasonic)	0.04	8.0	50W
17	Electric Hair Clippers (WAHL)	0.08	8.0	10W
18	Battery Charger (Nokia) : Charging Fully charged, trickle	0.04	8.0	5 W
		0.02	8.0	3 W

5. Discussion

From Table 1, it can be observed that appliances that consume most electricity are shown on the top of the table. The biggest electricity users in the home tend to be heating appliances. When considering saving electricity, focus must be on these big energy consumers. When using an electric cooking stove, it has been observed that a lot of heat is lost when you switch off the heating system at the end of cooking in stead of gradually reducing the heat. It was also observed that when the door of your griller is open, you lose a lot of energy. The microwave uses lot energy, but does take a shorter time to heat the food. It has also been discovered that several appliances consume energy when they are in standby mode. This includes Computer display, TV, Decoder, Radio as well as Microwave Oven. The charger also continues to consume electricity when the phone is fully charged although the energy is small. The pie chart in Figure 1 also illustrates, which category of appliances, by percentage consume the most energy.

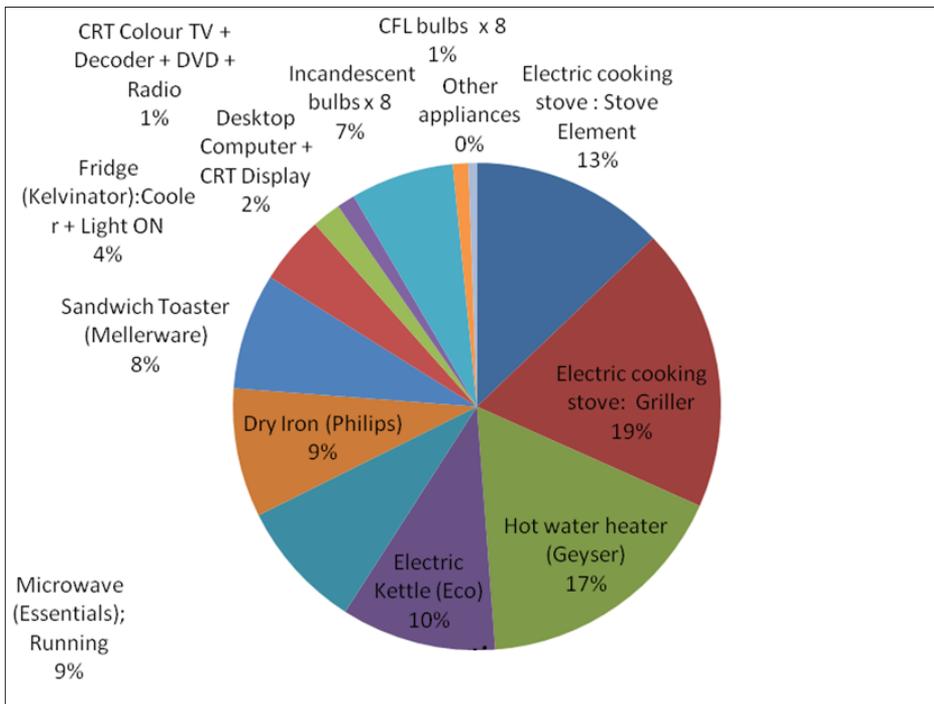


Figure 1: Power consumption of selected household appliances

From the pie chart, it must be noted that although, incandescent bulbs consume only 7 % of the household electricity, its comparison with the low-energy florescent bulbs, that consumes only 1 % is a huge saving. You can get a wide range of low-energy light bulbs that use about a fifth of the energy of traditional incandescent bulbs, for the same amount of light. Although they cost a little more to buy initially, they will last longer than traditional incandescent bulbs, and will quickly pay for themselves over and over again by saving money on energy bills. The low energy light bulbs come in different types namely; CFL, Energy saving halogen light bulbs and LEDs. CFL (Compact florescent lighting) bulbs are the most common energy saving light bulbs and come in different designs; such as candle, spiral and spotlight, depending on the way that the glass tubes are folded. CFLs contain 4 mg of mercury which is toxic. However, their toxicity will only come in

the way of breakages and eventual dispose. For it to be a health threat, you need at least 50 bulbs in one room. CFLs provide the same amount of power as incandescent bulbs, but use far less power, and last as many times longer. Over the lifetime of a CFL bulb, the electricity cost savings amount to many times the initial cost of the bulb, and carbon emissions from the power stations are reduced. They consume around 85 % less electricity than standard incandescent bulbs. It must also be noted that most appliances in standby-mode- consume- energy.

6. Recommendations

From the results presented in the paper, together with the analysis made, the following are recommendations to help households reduce electricity consumption:

- 6.1.** Do not leave your television and other entertainment devices in standby mode. In the average home, electricity is consumed while the products are turned off. This can be avoided by unplugging the appliance.
- 6.2.** Replace all of your inefficient incandescent light bulbs with energy efficient Compact fluorescent lamps (CFLs).
- 6.3.** Cook many items at the same time when your cooking stove is hot.
- 6.4.** Use a microwave to reheat food. Although a microwave uses a lot of power, it does so over a very short time and so saves energy overall.
- 6.5.** Turn down your heating system. For every degree you lower your heat you can reduce power consumption.
- 6.6.** Keep your fridge full, but not so full that air cannot circulate properly.
- 6.7.** Cool cooked food before you put it into the fridge.
- 6.8.** Do not put uncovered liquids into the fridge. Their evaporation will make the fridge to work harder.
- 6.9.** Don't keep opening the griller door when cooking. Every time you do so, your oven loses 20°C of heat.
- 6.10.** Boil water in a kettle rather than in a pot to save 50-70% of the energy and to get your water boiled faster.
- 6.11.** One should make it a point to switch off cell phone chargers from the mains after use, so that they do not consume power. The cell phone charger utilizes 3 watts per hour, when it remains plugged. So once the battery is charged, we should take the charger off the plug point.
- 6.12.** It is better to install two 15 watt Compact Fluorescent Lights at opposite sides of the room rather than installing a single 30 watt tube-light. The benefit is you can opt for only one of the CFLs if you do not need bright light all the time.
- 6.13.** There is a common misconception that screen savers reduce energy use by monitors; they do not. Automatic switching to sleep mode or manually turning monitors off is always the better energy-saving strategy.
- 6.14.** Turn off lights when there is no one is in the room. Home's electricity costs can be controlled with the flip of a switch.

7. Conclusions

In this paper energy measurement for various household appliances has been designed to find ways of reducing the power consumption. One of the most relevant aspects of this analysis consists of providing

recommendations based on measurements to allow users of electricity to reduce power consumption, save on electricity bills and eventually increasing access to the majority lot who are not connected to the grid. Saving energy also helps to control the amount of carbon dioxide emissions, which tends to contribute significantly to global warming. The paper has also shown that CFL bulbs are a better alternative compared to incandescent bulbs. They are more expensive, but last much longer and use much less energy; producing significant savings over the life of the bulb. It is therefore encouraged to opt for the highly efficient energy CFL bulbs for the households.

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