

**IEBMC 2017**  
**8<sup>th</sup> International Economics and Business Management**  
**Conference**

**LAPTOP OR DESKTOP? AN ESTIMATION OF POTENTIAL**  
**ENERGY SAVINGS IN COBA UNITEN**

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*Abstract*

Desktop computers have been identified as one the biggest source of energy usage in a building based on plug load. It has also been established that laptop computers, on the other hand used much less energy due to its efficient design. There are 107 academicians at the College of Business Management and Accounting, Universiti Tenaga Nasional who all provided desktop computers to work on. As such, it is inferred that those desktop computers use a lot of energy, incurring high energy bill for the university in the process. This paper estimated the energy used by the desktop computer of said academicians as well as the energy usage of its laptop equivalent. The potential energy savings, should a migration to laptop based computing environment happened, is then highlighted. Desktop computer of COBA academicians is estimated to use 43,527 kWh of energy annually which is equivalent to RM15,887.57 in energy bill. Laptop computer, on the other hand, is estimated to only use 9265 kWh of energy annually or RM3381.85 in energy bill. All in all, this potentially translates into 34,262 kWh of energy savings or the equivalent of RM12,505.72 in energy bill, a 79% reduction.

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**Keywords:** Energy saving, energy efficiency, desktop, laptop, computer, UNITEN.



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## 1. Introduction

In an era where energy efficiency is a buzzword that is mentioned in the same breath of renewable energy, low power appliances such as computers are now seen as a major energy use. A study by New Building (2012) found that plug loads can account for up to 50% of building's electricity usage. Delving deeper into this usage, a monitoring study conducted by Moorefield et al. (2011) indicated that computers accounted for 66% of small energy consumption in offices. This was confirmed by Gandhi and Brager (2016) who found that desktop computers consume the most energy per person. An assessment of research for small scale power demand and consumption revealed that no studies have ever been undertaken to evaluate the energy savings that could be made possible by switching from desktop to laptop in a higher learning and research institute, much less a higher learning institute that claims a forte in the area of energy. As such, there is a great potential for energy savings in such an institution.

The focus of this paper would be on the energy usage of computers. According to Menezes et al. (2013), computers are observed to be the single biggest source of energy usage. As observed in Table 01, the same author noted that in the case of desktop computers, the power usage ranges between 64 to 169 Watts. These figures are in line with modern desktop computers specification. As for laptop, there is a stark difference in energy usage. Menezes et al. (2014) noted that laptop computers only consumed between 18-41 Watts of power during active usage. Since energy efficiency is a key issue for laptops, they have lower energy usage.

**Table 01.** Energy usage comparison between desktop and laptop

Type of computer	Power usage (W)
Desktop computers	64-169
Laptop computers	18-41

## 2. Problem Statement

According to Bray (2006), usage of laptop computers presents an opportunity for energy savings in an office environment. Speaking at a CM Summit, Meeker, Devitt, Wu (2010) announced that laptop shipment figures are projected to surpass that of desktop. This is indicative of a trend in the computing environment to switch from desktop to laptop. As such, conversion or migration from desktop based to laptop based computing environment would result in greater energy savings which would then lead to better energy efficiency. This is even more so in the age of the renewable energy where intermittency issue with non dispatchable power demands greater energy efficiency from end users as intermittent renewable energy might not be able to provide sufficient energy to fulfil demand during peak working period.

As stated earlier, there is a lack of studies on the potential energy savings resulting from the conversion from a desktop based computing to laptop based computing, especially in a higher learning institute environment. Most studies focused on the aspect of energy efficiency of office equipment by means of benchmarking; also on the energy saving potential through power management. The best way to demonstrate the potential energy saving from this conversion is by an estimation exercise in a higher learning institute which specializes in the field of energy studies.

### **3. Research Questions**

#### **3.1. What is the estimated energy consumption of HP desktops in use by COBA academicians and its laptop equivalent?**

Based on several usage parameter assumptions, this paper answered this question by providing the estimated aggregate annual energy consumption in kWh for desktop and laptop. As outlined in the research method section below, there is no actual measurement of energy through a power meter. A future, more in-depth study should use a power meter to accurately gauge the actual energy consumption of these desktop computers.

#### **3.2. What is the estimated energy savings from the migration to laptop use?**

Based on the tariff category of UNITEN, this paper answered this question by providing an estimated energy saving in terms of RM, by multiplying the kWh figure (as per the answer for the first research question with per unit electricity cost. Again, as the answer for the first research question is an estimation only, the energy savings, which is based on estimated energy consumption, will be purely an estimation.

### **4. Purpose of the Study**

The aim of this paper is to provide an estimation of potential energy savings that could be achieved by migrating from desktop based computing environment to a laptop based, from the usage of academicians based in College of Business Management and Accounting (COBA), Universiti Tenaga Nasional (UNITEN). This author observed that employees of the parent company of UNITEN, TNB, were equipped with laptops. As such, this paper intends to gauge the energy savings should UNITEN were to follow the policy of its parent company. This paper is exploratory and desktop in nature with its output meant to guide follow up and more detailed studies that could recommend policy changes.

### **5. Research Methods**

The estimations in this paper are made based on technical data several secondary sources including guidelines from Sustainable Energy Development Authority Malaysia (SEDA Malaysia) and Hewlett-Packard Development Company (HP) as from Menezes et. al (2014) findings. Data from HP was used in lieu of direct measurement since from the observation of this author, most if not all desktop computers used in COBA are of the HP brand. Data from SEDA and literature are used to estimate usage period as well as for power consumption of laptop computer.

#### **5.1. SEDA Guideline on Office Energy Saving**

SEDA (2017) outlines four different usage profiles for a desktop computer; shutdown, sleep, on screensaver and active. It defines active as usage during office hours while sleep is defined as using very minimal power. The guideline states that a desktop computer with a LCD monitor consumes 70 Watts of power during active usage.

## 5.2. Hewlett-Packard Development Company

HP (2008) published a whitepaper meant as its desktop computers power usage estimator. Similar to SEDA, HP outlines four usage profiles with an average power usage 380 Watts of power. Based on the assumption of 4 hours of active usage, 4 hours of idle and 16 hours of sleep, this translates into 1541.6 Watt-hours of energy usage.

### Menezes et al. (2014)

The authors have published energy requirement figures for desktop and laptop computers. Laptop computers were estimated to use between 18-41 Watts of power, which is not far off from data provided by SEDA. For the purpose of this study, the author will assume that laptop computers will used the full 41 Watts of power in lieu of direct measurement.

## 5.2. Assumptions

Since this paper aims to provide an estimation (with the intention of a follow up study), several assumptions have to be made. First, the usage duration is based on the HP whitepaper that is 4 hours of active usage, 4 hours of idle and 16 hours of sleep. This is then followed by a 22 working days times 12 months. This is then calculated against a tariff of RM0.365 per kWh (C1 Commercial Tariff band). To complete the assumptions, the following number of COBA academicians gathered from the UNITEN website is then used as indicators of the number of computers in use. This scope of this study will only be limited to the computing usage of academicians, as such, the numbers of supporting and administrative staff is not included.

**Table 02.** Academic staff numbers (as of 2017)

Department	Numbers
Finance and Economics	27
Accounting	40
Management and Human Resource	29
Marketing and Entrepreneurial Ventures	11
TOTAL	107

## 6. Findings

The findings of this paper is divided into two parts; the first is an estimation of power usage of desktop computers in use by COBA academicians while the second part is an estimation of power usage of laptop equivalent. Next, the potential energy savings in terms of kWh as well as in RM terms from the usage of laptops is then presented.

### 6.1. Power usage estimation for desktop computers

The estimation indicates that, based on the assumptions outlined in the research method section above, the total energy usage is 43,527 kWh which equates to the amount of RM15,887.57 that UNITEN has to fork out for energy bill annually.

**Table 03.** Desktop computers power usage data (2017)

Average Energy Usage Per Desktop	Times Working Days	Times Months	Times Staff Number	Total Energy Usage	Energy Bill
1541.6Wh	22	12	107	43,527 kWh @ 43.5 GWh	RM 15887.57

### 6.2. Power usage estimation for laptop computers

Laptop computers present a unique situation for estimation. As laptops are generally more power efficient, it is assumed to consume only 41 Watts for both 4 hours of active usage and 4 hours of idle; very minimal power is assumed to be used during sleep as the laptop would have gone into hibernation mode. Thus, a laptop is estimated to use only 328 Wh of energy per day. The estimation indicates that, based on the assumptions outlined in the research method section, the total energy usage is 9,265 kWh which equates to the amount of RM3381.85 that UNITEN has to fork out for energy bill annually.

**Table 04.** Laptop computers power usage data (2017)

Average Energy Usage per laptop	times Working days	times Months	times Staff number	Total energy usage	Energy bill
328Wh	22	12	107	9,265 kWh @ 9.2 GWh	RM 3381.85

### 6.3. Power savings potential

The estimation data indicates that a migration to laptop computers, based on the assumptions outlined, have the potential to generate an energy savings of 79%, both in kWh and RM terms.

**Table 05.** Energy savings potential (2017)

Annual desktop energy usage	Annual laptop energy usage	Energy savings	Annual desktop energy bill	Annual laptop energy bill	Energy bill savings
43,527 kWh	9,265 kWh	34,262 kWh (79%)	RM15,887.57	RM3381.85	RM12,505.72 (79%)

## 7. Conclusion

Academicians at COBA, UNITEN were each provided a desktop computer as part of their office equipment. The desktop computer in question is of the HP brand with LCD monitor. It has been proven in the literature that desktop computers are one of the biggest source of energy usage in an office environment. This finding is further supported by HP's own whitepaper and is corroborated by this author's observation on his own desktop computer which has a 240 Watts power rating (excluding the monitor).

This study aims to provide an estimation of the energy savings potential should desktop computers were migrated to laptops. Two research questions were proposed which were the estimated power consumption of HP desktops used by COBA academicians as well as its laptop equivalent and the estimated energy savings from migration to laptops. Based on secondary data and several assumptions, the two research questions have been answered thus fulfilling the purpose of this study.

It is estimated that COBA academicians, on aggregate, used 43,527 kWh of energy annually through their desktop computers, raking up RM15, 887.57 in electricity bill that needs to be footed by the university.

In contrast, should COBA academicians were to be provided with laptops, on aggregate, the annual energy consumption is estimated to be only 9,265 kWh or RM3381.85 in electricity bill. Therefore, the potential energy saving is 34,262 kWh or RM12,505.72 which is a 79% reduction. The author believes that this energy saving potential is a testament of interdisciplinary sustainability perspective and augurs well with UNITEN's Smart UniverCity framework.

### 7.1. Limitations

As this paper is only intended as an estimation, only secondary data and assumption were used as basis for this study. This is especially for the laptop power usage data which is generic in nature. Also, the actual computer usage pattern of COBA academicians were substituted with assumption data provided by SEDA.

### 7.2. Future research recommendations

A more thorough and comprehensive study would require the usage of power meter to accurately measure computer power usage as well as the actual usage pattern of COBA academicians. To further provide a more solid empirical evidence, the study could include supporting staff. This would enable a more accurate modelling of the energy saving potential. In order to prove a solid case for laptop computers, suitable actual brand and variant must be identified and its power usage measured. Additionally, future study could include the cost of acquiring desktop versus laptop as well as the relevant return on investment and payback period so as to provide a better input for policy making.

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