

A STUDY OF ELECTRICAL ENERGY EFFICIENCY BUILDING

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ABSTRACT

The objective of this study is to reduce energy handling costs by introducing electrical energy efficiency programs such as improving the efficiency of lighting, reducing the loss of internal energy transmission on power cables and replacing inefficient equipment with energy efficient products to reduce the cost of electricity. In this study, energy analysis and energy consumption inefficiencies have been determined by scheduling energy consumption and expenditure by referring to last year's monthly electricity spending statement for 3 years. Monitoring of power consumption is to calculate the changing values such as power factor values, and reactive energy using power monitoring meters. Data analysis reveals that the practice of energy efficiency program techniques can be implemented to ease the inefficient use of energy and the reduction in electricity costs.

Keywords: Energy Efficiency, Energy Audit Program

1.0 INTRODUCTION

Efficient energy use, sometimes simply called energy efficiency, is the goal to reduce the amount of energy required to provide products and services. For example, insulating a home allows a building to use less heating and cooling energy to achieve and maintain a comfortable temperature. Installing LED lighting, fluorescent lighting, or natural skylight windows reduces the amount of energy required to attain the same level of illumination compared to using traditional incandescent light bulbs. Improvements in energy efficiency are generally achieved by adopting a more efficient technology or production process^[1] or by application of commonly accepted methods to reduce energy losses.

Energy efficiency has proved to be a cost-effective strategy for building economies without necessarily increasing energy consumption. For example, the state of California began implementing energy-efficiency measures in the mid-1970s, including building code and appliance standards with strict efficiency requirements. During the following years, California's energy consumption has remained approximately flat on a per capita basis while national US consumption doubled.^[5] As part of its strategy, California implemented a "loading order" for new energy resources that puts energy efficiency first, renewable electricity supplies second, and new fossil-fired power plants last.^[6] States such as Connecticut and New York have created quasi-public Green Banks to help residential and commercial building-owners finance energy efficiency upgrades that reduce emissions and cut consumers' energy costs.^[7]

Lovin's Rocky Mountain Institute points out that in industrial settings, "there are abundant opportunities to save 70% to 90% of the energy and cost for lighting, fan, and pump systems; 50% for electric motors; and 60% in areas such as heating, cooling, office equipment, and appliances." In general, up to 75% of the electricity used in the US today could be saved with efficiency measures that cost less than the electricity itself, the same holds true for home settings. The US Department of Energy has stated that there is potential for energy saving in the magnitude of 90 Billion kWh by increasing home energy efficiency.^[8]

Other studies have emphasized this. A report published in 2006 by the McKinsey Global Institute, asserted that "there are sufficient economically viable opportunities for energy-productivity improvements that could keep global energy-demand growth at less than 1 percent per annum"—less than half of the 2.2 percent average growth anticipated through 2020 in a business-as-usual scenario.^[9] Energy productivity, which measures the output and quality of goods and services per unit of energy input, can come from either reducing the amount of energy required to produce something, or from increasing the quantity or quality of goods and services from the same amount of energy.

The Vienna Climate Change Talks 2007 Report, under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC),

clearly shows "that energy efficiency can achieve real emission reductions at low cost."^[10] International standards ISO 17743 and ISO 17742 provide a documented methodology for calculating and reporting on energy savings and energy efficiency for countries and cities.^{[11][12]}

2.0 IMPACT OF THE ENERGY EFFICIENCY DIRECTIVE

Energy efficiency is an answer to many problems. It is critical to reduce energy demand and moderate energy prices, and bring lower energy bills for both consumers and industries. Consequently, it will enhance competitiveness of EU industries and the economy as a whole. Saving energy can help reduce our dependency on foreign fossil fuels, and avoid costly investments in new energy infrastructures.

If taken up seriously, energy efficiency measures can create numerous jobs in construction and installation for decades to come. On top, it is a highly cost-effective option to reduce greenhouse gas emissions. Yet, in spite of all these wonderful benefits it has turned out very difficult to reduce energy consumption. While the EU planned for 20% primary energy savings by 2020 compared to a baseline, a considerable gap still exists.

The Energy Efficiency Directive (EED), on which the European Parliament and the Council agreed in the second half of 2012, must change this. The EED is a compromise deal that is expected to result in 15% energy savings by 2020. The gap with the 20% target will be filled partly by additional fuel-efficiency regulations under the Ecodesign Directive, resulting in another 2% savings. Member States will have two years to implement the EED in their national legislations. In the first half of 2014, the Commission will review progress and assess whether further measures are needed to meet the 20% savings target. It is very likely that this will be the case. The Directive itself will be reviewed in 2016.

The EED will affect the full energy chain: energy conversion, transmission and distribution, and end-use. The full implementation of all measures will therefore concern a wide variety of stakeholders.

2.1 Impact on National Governments

All Member State must set a national non-binding energy efficiency target for 2020 by April 2013. They will report on progress annually and submit a detailed National Energy Efficiency Action Plan every three years. Besides, central governments must include high energy efficiency performance in their purchasing policies.

2.2 Impact on The Built Environment

Member States must make a roadmap to make their entire building stock more energy efficient by 2050, and include policies and measures for cost-effective deep renovations. In addition, 3% of floor area of central government buildings must be renovated annually.

2.3 Impact on the Energy Sector

Member States must set up an energy efficiency obligation scheme, under which energy distributors or retailers will save on average 1.5% per year on energy sales. Flexibility clauses may be applied that may lower this effort by up to 25%. Member States may also choose to implement alternative policy measures with an equivalent outcome, although the flexibility clauses would not apply then.

2.4 Impact on Electricity Grids

A variety of measures for saving energy in grids is included in the Directive. Member States must ensure that the energy savings potentials of their gas and electricity infrastructure is assessed, and that measures to improve energy efficiency are identified. It is also required to remove disincentives for a more efficient energy use from grid tariffs.

2.5 Impact on Industry

The cost-effectiveness of high efficiency cogeneration and the use of waste heat must be assessed for large (>20 MWth) installations. These installations include thermal electricity generation and industrial installations, either newly built or refurbished. A comprehensive assessment of the potential for cogeneration and district heating must be carried out at the national level, based on a cost benefit analysis. Member States must take measures to ensure that cost-effective potential is realised. Energy audits will be mandatory for large industries, while Member States must encourage them for small and medium enterprises.

A well prepared implementation of the Directive is vital to unleash its full environmental and economic potential in the coming years. Ecofys has the right expertise to contribute to this challenging task. Our work offers a wide range of support in that regard already today. For instance, we have illustrated best possible ways forward to renovate the European building stock, on behalf of Eurima. Together with the Wuppertal Institute, Ecofys identified best practices from the National Energy Efficiency Action Plans of several Member States. Lately, we investigated how the use of smart end-use energy storage might facilitate the grid integration of renewables. And for the industry sector, a striking

example of benefits from enhanced energy efficiency is the very considerable potential related to industrial insulation.

3.0 THE FUTURE OF ENERGY EFFICIENCY

3.1 LED Bulbs

One of the easiest ways to save energy is to switch standard light bulbs with LED bulbs, which consume far less energy and last much longer than traditional bulbs. However, LED light bulbs are also much more expensive, which is why some people are hesitant to make the switch. Fortunately, this may not be a problem beginning in 2018, since the price of LED light bulbs is expected to drop over the next several months. Now that LED light bulbs are more affordable, more homeowners can switch to these energy efficient bulbs and start saving energy at home.

In the future, more homeowners may rely on wireless energy monitors to help them become more energy efficient. Energy monitors connect to a home's electricity meter so they can show you how much energy is being used in real time. Some of the more advanced models can even tell you which appliances are using the most energy so you know which ones should be shut off when they're not in use. Energy monitors also connect to your smartphone so you can keep track of your home's energy use wherever you are. As these devices become more popular, it will become even easier for people to keep track of their energy use and work towards a more energy efficient lifestyle.

As can see, there's a lot going on in the world of energy efficiency in 2018. It's impossible to know for certain what the future has in store, but based on these predictions, the future of energy efficiency is as bright as an LED bulb.

3.2 Smart Windows

A number of new technologies are currently being developed that could transform the way people consume energy at home and on the go. Engineers at Stanford University have developed a smart window that switches from opaque to transparent in less than a minute. When the window is transparent, it allows about 80% of natural light to pass through it. Transparent windows would work well in the winter, when people allow natural light into their homes so they don't have to use the heater to warm up. However, when the window becomes opaque, it blocks nearly 95% of natural light. This would be ideal in the summer, when people want to block natural light to keep the inside of their homes cool. The engineers plan on testing large-sized prototypes in 2018 and are hoping to have the product ready for commercial use by the end of the year.

3.3 Inexpensive Solar Panels

This isn't the only technology that engineers at Stanford are working on. Engineers are also in the process of developing a lighter, more inexpensive material that can be used to produce solar panels. Right now, many people don't even consider solar panels as an option because they are so expensive. If costs can be lowered significantly, this would make powering homes with solar energy more practical and affordable. The team at Stanford is experimenting with crystalline perovskites, which could be used to harness the power of the sun at a fraction of the price of traditional solar panels.

3.4 New Solutions for Warm Weather

In the future, people may not need to rely on their air conditioners to keep them cool during the hot summer months. Instead, they may turn to a new fabric that is designed to keep the wearer cool and comfortable. How does it work? Many fabrics—including cotton—trap the majority of the heat emitted from the person's body. Because the heat is trapped, the person wearing the fabric becomes hot and uncomfortable. However, this new fabric allows the majority of the heat emitted from the wearer's body to escape, thus lowering the wearer's body temperature. With this new fabric, people may not need to rely as heavily on their air conditioner to stay comfortable.

4.0 RESEARCH AREA AND METHODOLOGY

The University College of Islam Melaka is a private higher learning institution wholly owned by the State Government of Melaka. This institution was established under the Act of Private Higher Educational Institutions 1996. The State Government is committed in excelling the education in conformity with the slogan Melaka Developed State 2010. Furthermore, on 1st July 2009, The Ministry of Higher Education has agreed to upgrade this institution to be a university college. As of May 2017, the number of students who are still actively enrolling in KUIM is 4, 562 and 357 staff. This survey is a green audit over the use of electricity at KUIM. Among the data sources of this study are electricity bills for six focal areas for 2014 to 2016. The electricity bill payment data is used to examine the electricity consumption trend for all study focus areas. Six focus areas are chancellery building, faculties, cafeteria, Stadium Thariq Ziyad, pump house of Saidina Abu Bakar Apartment and Masjid Al-Ilmi. This study also put forward suggestions on how to converse electricity efficiently.

5.0 DATA COLLECTION AND ANALYSIS

Secondary data finding from the formulation of electricity bill payment by area in 2014 to 2016 is shown in Table 1. The findings show that KUIM has to pay an

electricity bill of RM 966, 345.97 in 2014, RM 1, 051,315.69 in 2015 and RM 1, 104, 378.89 in 2016. This shows the average amount of electricity bills payable to reach millions of ringgit.

Table 1: Total electric Bill for 2014-2016

Year	Electric Bill (RM)
2014	966, 345.97
2015	1,051,315.69
2016	1, 104, 378.89

Table 2: Electricity bill according to building and focus area for 2014-2016

Area	2014 (RM)	2015 (RM)	2016(RM)
Chancellery	456, 205.70	509, 487.72	526, 225.00
Faculty	363, 794.90	372,310.99	397, 209.61
Pump House	68, 274.47	73, 589.23	80, 389.74
Cafeteria	25, 230.32	38, 620.37	47, 505.37
Stadium Thariq Ziyad	29, 403.77	31, 496.48	28, 705.76
Masjid Al-Ilmi	23, 260.48	26, 871.31	25, 969.50

The Chancellery block is the main office building such as Vice-Chancellor's office, Deputy Vice-Chancellor, administrative office, finance unit office, academic affairs office and student affairs office. High consumption due to equipment such as computers, lamps and air conditioning is widely used in this building.

The use of lighting and air conditioning is largely influenced by the shape of a building and the arrangement of the furniture in the building where most windows install a light-retaining bar. Observations found that most departments and units used light shutters and curtains. In addition, due to the lack of space to put many files, additional shelves are made close to the windows. This causes most offices not to rely on lighting from sunlight and air-conditioning for ventilation. After all, there are still many types of air-

conditioning that are still in use. Although some lecture rooms, departments and units have transformed air conditioners into new types like York and others, but still have the old type air-conditioning used.

Findings on equipment also show fluorescent lamps commonly used extensively throughout the KUIM Campus building. This gives potential to the high electricity bills. However, there is a more energy saving lamp option that is compact / compact fluorescent lamps or LED fluorescent lamps. Compact fluorescent lamps use 75% of the energy compared to ordinary fluorescent lamps and have a lifespan of 10 times too. LED lighting can save electricity because it only produces three watts of energy as well as reducing global warming that is a hot issue debated. However, the usual fluorescent lamp conversion has been rationale for implementation at KUIM. This is because the conversion may cost a lot. However, if new developments are made, compact fluorescent lamps should be given priority especially for lamps installed in corridors, stairs and KUIM environments.

6.0 CONCLUSION

There are many motivations to improve energy efficiency. Reducing energy use reduces energy costs and may result in a financial cost saving to consumers if the energy savings offset any additional costs of implementing an energy efficient technology. Reducing energy use is also seen as a solution to the problem of reducing greenhouse gas emissions. According to the International Energy Agency, improved energy efficiency in buildings, industrial processes and transportation could reduce the world's energy needs in 2050 by one third, and help control global emissions of greenhouse gases.^[2] Another important solution is to remove government-led energy subsidies that promote high energy consumption and inefficient energy use in more than half of the countries in the world.^[3]

Energy efficiency and renewable energy are said to be the *twin pillars* of sustainable energy policy^[4] and are high priorities in the sustainable energy hierarchy. In many countries energy efficiency is also seen to have a national security benefit because it can be used to reduce the level of energy imports from foreign countries and may slow down the rate at which domestic energy resources are depleted.

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