Economic and Environment Benefits of using Energy Saving Equipment for Fluorescent Lamps in Vietnamese schools.

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Abstract:

Saving energy is of crucial concern nowadays in the context of global climate change in general and in sustainable manufacturing and environmental management in particular. There are many systems created to save energy for lighting systems such as LED, compact lighting, etc. However, the cost of using these products is still a problem for Vietnamese consumers. Therefore, having energy saving equipment for fluorescent lamps is essential. This study presents an analysis of the economic and environmental benefits based on energy saving equipment for 50-fluorescent lamps (TKD-N50 got the patent on April 16th, 2012 in Vietnam) which can save from 30% up to 50% of consumed power. We use the available statistical data from the website of the General Statistical Office of Vietnam (GSO of Vietnam) on this product's objectives, i.e. the number of schools and classes of kindergarten education and the number of schools and classes of general education throughout Vietnam in the case that they are willing to use TKD-N50. We assume that there are only 250.000 rooms out of the existing class rooms which are suitable for installing TKD-N50 and are willing to equip this energy saving equipment. In this case, our estimated results clearly demonstrate the benefits to the environment and the value to businesses balance sheets. For each year, we can save around 688 billion VND, from 330 million KWh to 550 million KWh of electric energy and reduce 141.750 tons to 236.500 tons carbon emitted into our environment.

Keywords: Electrical energy saving, Fluorescent lamp, Carbon emissions.

I. INTRODUCTION

In recent decades, along with the expansion of economic activities, growing global environmental

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concerns have been raised, such as climate change, energy security and the increasing scarcity of resources. Energy has become the life-blood for the continual progress of mankind and civilization. Global energy consumption has increased substantially to accelerate improvements in the human standard of living. In fact, per-capita energy consumption has been one of the major barometers of a nation's economic prosperity. The USA has the highest living standard in the world. With only 5% of the world population it consumes 25% of total global energy, whereas there are at least 1.6 billion rural poor people from developing countries and less-developed countries (one-fourth of the world's population) currently living without electricity. [1] Meeting the energy demand of people who still lack access to basic, modern energy services while simultaneously participating in a global transition to clean, low-carbon energy systems has been a top priority for many governments.

Obviously, however, the available resources of energy are limited. Therefore, there is an urgent demand to locate and harness new sources of energy or to use the available ones judiciously and effectively so as to make them last longer in order to have an energy secure future for our coming generations. There is also a need to implement new lighting designs or to improve and maximize utilization of existing lighting systems in order to reduce the level of energy use and greenhouse gas emissions.

Up to now 37 industrialized countries have signed up to the Kyoto Protocol[2] and are generally committed to a reduction of four greenhouse gases (GHG) (carbon dioxide, methane, nitrous oxide, sulphur hexafluoride) and two groups of gases (hydro fluorocarbons and perfluorocarbons) produced by them. In response, manufacturing industries in many advanced countries have recently devised a variety of new methods for saving energy. New measures are required in addition to existing measures, especially for reducing the use of fossil energy.

Lighting is a major source of power consumption in most countries of the world. Many countries have promoted measures for reducing greenhouse gas emissions and to support this have issued policies banning the use of incandescent light bulbs which are less efficient than fluorescent lamps. For instance, the Vietnamese Government has issued decision No. 51/2011/QD-TTg coming into effect from 01/01/2013 that bans the production and circulation of incandescent lamps with a power over 60W. Therefore, many effective methods for saving the energy used by fluorescent lamps, such as electronic ballast, dimming ballast, double power ballast, etc, have already been launched. However, the cost of using these products is still a big concern for low-income and middle-income countries which lack electricity, such as Vietnam.

To overcome these difficulties, Vietnamese scientists have created new energy saving equipment for 50-fluorescent lamps with dimmable control (TKD-N50 (see Figure 1 in Appendix) got the patent on April 16th, 2012 in Vietnam) which can save from 30% up to 50% of consumed power and tackle the financial problem for Vietnamese consumers. This equipment works on the principle of keeping lighting energy constant in the room by using the natural lighting energy to save power. It is aimed at schools, universities, offices, supermarkets, textile mills, production facilities and seafood processing factories, etc.

Unfortunately, this study can only obtain

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[1] See Dilip Ahuja and Marika Tatsutani (2009).

[2] See http://unfccc.int/kyoto_protocol/items/2830.php/

available data from the GSO of Vietnam on the number of schools and classes of kindergarten education and the number of schools and classes of general education throughout Vietnam for our research purposes. Therefore, for Vietnamese kindergarten schools and junior and secondary schools, we will base the study on these data for examining and comparing the costs and benefits between the actual costs of electricity bills without energy saving equipment installed and in the case they are willing to use TKD-N50. We also estimate the reduction of CO2 emissions into the environment. Our results will clearly demonstrate both the benefits to the environment and the value to businesses balance sheets.

The remainder of this study is structured as follows. In section 2, a brief literature review is presented. In section 3, the analytical framework is discussed. The data descriptions and the empirical results are presented in section 4 and section 5 will conclude.

II. LITERATURE REVIEW

Many methods and products for saving energy and conserving energy have been introduced so far. Meanwhile, there is also a lot of research studying energy saving lighting efficiency technologies and energy management such as Haideri and Paraskiewicz (1993), Kawamoto and Nakamura (2005), Fritz and Kahn (2006), Mohelnikova (2008), Takei (2009), Dhingra and Singh (2009), Shailesh and Raikar (2010), etc.

Generally speaking, these theoretical and empirical analyses of energy saving lighting efficiency technologies can be classified into three main groups.

The first group investigates energy saving lamps (ESLs) and/or focuses on new types of lamp which can save energy such as LED and CFLs (compact fluorescent lamps). The recent progress in development of advanced high brightness and white light emitting diodes (LEDs) has been reported with two main orientations in LED fabrication based on inorganic and organic semiconductor materials. LEDs offer a number of advantages compared to existing light sources in optoelectronic applications. These include increased lifetime, reduced power consumption, higher brightness and better spectral purity. For example, Takei (2009) summarized the development of energy saving and the trends of the most advanced technologies for efficient lighting. Sun, Tsuei and Huan (2011) describe the advantage of using white LEDs in different spaces of the general household lighting.

The second group focuses on improving the energy efficiency of lighting systems like improving electronic ballast, dimming ballast and other methods which can save energy for lighting systems etc. Wu and Lam (2003) investigated the benefits of an office lighting retrofit using T5 fluorescent lamps and electronic ballasts. Deneyer, D'Herdt, and Diga (2006) discussed and evaluate the performance of dimmable lighting sources with fluorescent tubes for indoor applications. Colaco, Kurian, George and Colaco (2010) discovered acceptable ranges of dimming control voltage that would gratify both the electrical and photometric performance of luminaries. They recognized that there may be a few high frequency electronic dimmable ballasts which are indeed as per national/international specifications.

The last group focuses on finding new methods for saving energy management of fluorescent lamps and their applications for buildings, schools, factories, etc. For instance, Mohelinikova (2008) discussed the tubular light guides that are systems which serve to provide natural illumination of the internal windowless parts of buildings. Their function is based on the principle of light transfer from outdoor to distant indoor places due to multi-reflections on their high reflective internal surfaces. Silva, Chagas, Lopes, Schlittler, Seidel, Costa and Prado (2009) presented an analysis of the benefit-cost ratio of turning off or not a fluorescent lamp in small time intervals, based on the relation between energy consumption and lamp lifetime depreciation. Fritz and Kahn (2006) recommended the energy consumption reduction methods for a school in Worcester, South Africa.

Whereas there are a number of studies that evaluate the potential energy saving for a side-lit room using daylight-linked fluorescent lamp installations for office buildings or lighting and energy performance in offices, such as Haideri and Paraskiewicz (1993), To, Leung, Chung and Leung (2000), Li and Lam (2001) and Li, Lam and Wong (2006), and Fritz and Kahn (2006), etc., which just focused on analyzing specific office buildings in their country, there have so far been no studies on the economic and environmental costs and benefits of using energy saving equipment for fluorescent lamps in developing countries such as Vietnam.

In Vietnam, according to the statistics of the Electric Power Corporation – from INFOTV, electrical energy consumption for lighting in Vietnam is in the range from 20% to 22% of the total national electrical energy consumption. Likewise, lighting in industrialized countries accounts for only about 10-15% of their total electrical energy use. Therefore, there is a pressing need to investigate efficient electrical energy consumption for lighting and giving the implications for energy saving consumption in Vietnam.

We employ available data on the number of schools and classes in Vietnam for analyzing the benefits derived by using energy saving equipment of TKD-N50 for addressing two issues including (1) comparing the costs and benefits between the actual costs of electricity bills without energy saving equipment installed and in the case they are willing to use energy saving equipment for fluorescent lamps, and (2) estimating the reduction of CO2 emissions into the environment in the case TKD-N50 installed in all Vietnamese schools.

III. FRAMEWORK

According to GSO of Vietnam, at the end of 2010, there were 12.678 kindergartens, 28.593 schools of general education, 414 universities and colleges, 717 libraries and 13.467 hospitals and clinics throughout of Vietnam. As of December 31st, 2008, the actual number of enterprises that were active includes 3.287 state enterprises, 196.776 non-state sector enterprises and 5.626 foreign-invested enterprises which are active including 7.266 enterprises of agriculture and forestry, 1.353 fisheries enterprises, 2.184 mining enterprises, 38,384 manufacturing enterprises, 3.117 production and distribution of electricity, gas and water enterprises, 28.311 construction-related businesses, 7.084 hotels and restaurants, 9.568 transportation, storage and communications companies, 1.635 financial credits enterprises, 150 science and technology enterprises, 21.996 consulting services businesses.

According to the reports of the Rang Dong and Dien Quang companies, the leading providers of optical bulbs in Vietnam, they sell about 150 million units per year. The above figures show that the potential market in Vietnam for the implementation of specific power-saving methods is very large. Thus, we can say, TKD-N50 would be suitable for the objects such as schools, universities, offices, supermarkets, textile mills, production facilities and seafood processing factories which potentially have higher electricity bills.

The product TKD-N50 is designed to manage 50 fluorescent lamps with a power of 40W each tube. So in one hour, the total consumed power of the lighting system is about 2 KWh for 50 fluorescent lamps. Assume that the lighting systems of universities and schools run for 10h per day, 22 days per month, and 10 months per year. In the case of without TKD-N50, the power consumption of 50 fluorescent lamps is 20 KWh per day, 440 KWh per month and 4.400 KWh per year. The results of performance testing indicate the saving performance for 50 fluorescent lamps installed with TKD-N50 is from 30% (in the case without natural lighting) to 50% (having natural lighting) of total consumed energy. With the band of savings in the range of 30-50% the total energy saving of the lighting system installed with TKD-N50 is from about 6 KWh to 10 KWh in one day, 132 KWh to 220 KWh in one month and 1.320 KWh to 2.200 KWh in one year. The price of electricity in terms of 1 KW is currently 1.252 VND for the objects including hospitals, kindergartens and schools supplied voltage of 6 kV or higher [3]. The total money paid for a year in the case without TKD-N50 for 50 fluorescent lamps is 5.508.800 VND for 4.400 KWh consumed in one year. If businesses are willing to buy and install the TKD-N50 at market price of 4 million VND per TKD-N50, the maximum saving money for using 50 fluorescent lamps (if can save for 50% total power consumption) is 2.754.400 VND/year. As a result, only after around 1.45 years, these businesses can get payback (See Table 1 in Appendix). The product life time of TKD-N50 is around from 8 years to 10 years. Obviously, TKD-N50 will bring economic benefits for users.

As far as environmental benefits are concerned, TKD-N50 can help to reduce carbon emissions to the environment. Using a conversion factor of 0.43kg for 1 KWh (based on online carbon calculator from the URL, http://www.resurgence.org/education/carbon-calculator.html), the reduction of carbon emitted to the environment is about 0.567 tons (Note 0.43 kg x 1.320 KWh is 0.567 tons) to 0.946 tons (Note 0.43 kg x 2.200 KWh is 0.946 tons) per year for a 50 - fluorescent lamp system.

IV. DATA AND RESULTS

To estimate economical benefits for Vietnamese kindergartens and schools if they are willing to install TKD-N50, and how much CO_2 emissions can be reduced, we use available data from the website of the GSO of Vietnam. According to the GSO of Vietnam, at the end of the year 2010, there were 28.593 schools of general education with 495.2 thousand class rooms throughout of Vietnam. Due to lack of financial support we cannot survey all schools throughout Vietnam to determine the class rooms' size that can tell us whether they should be suitable for installing TKD-N50 equipment or not. We assume that there are only 250.000 rooms out of the existing class rooms which are suitable for installing TKD-N50 and are willing to equip this energy saving equipment.

In economic terms, the investment needed to equip every class rooms with TKD-N50 is 1 thousand billion VND (250.000 rooms multiplied by 4 million VND per one TKD-N50). Thanks to TKD-N50, we can save a striking amount of approximately 688

[3] According to Circular No. 17/2012/TT-BCT dated 29/06/2012 of the Vietnamese Ministry of Industry and Trade of electricity price and guiding.

billion VND per year (250.000 rooms multiplied by 2.754.400 VND).

As far as saving energy is concerned, if 250.000 rooms equipped TKD-N50 turn on lamps 10 hour per day, 22 days per month, and 10 months per year, the electric consumption (without TKD-N50) is 1.1 billion KWh/year (250.000 rooms multiplied by 4.400 KWh/room/year) so the amount of energy saved using TKD-N50 can be from 330 million KWh (250.000 rooms x 1.320 KWh is 300 million KWh) to 550 million KWh (250.000 rooms x 2.200 KWh is 550 million KWh).

Moving onto the environmental benefits, if 250.000 rooms are equipped TKD-N50, the total reduction of carbon emitted to the environment ranges from 141.750 tons (250.000 rooms multiplied by 0.567 tons) to 236.500 tons (250.000 rooms multiplied by 0.946 tons).

V. CONCLUSTION

This paper presented a study on the economic as well as environmental benefits for Vietnamese schools and universities if they are willing to equip TKD-N50 in using the lighting system. We just assume that there are 250.000 rooms out of the existing class rooms which can be suitable for equipment. Based on this assumption, we find that the most obvious benefits gained from TKD-N50 are saving energy, saving money and reduction of carbon emissions. With 250.000 rooms which are running light system within 2.200 hours/year, if willing to use TKD-N50, they can save more or less 688 billion VND per year. Another valuable result of this is electric energy saving which can be from 330 million KWh/year to 550 million KWh/year. This scenario could also be favorable in terms of environmental benefit. The total reduction of carbon emitted to the environment ranges from 141.750 tons to 236.500 tons per year.

In fact, the objectives of the product TKD-N50 include schools, universities, offices, supermarkets, textile mills, production facilities and seafood processing factories. We need to do survey about other the objectives of TKD-N50 for further information about the benefits that TKD-N50 brings. This certainly merits further study.

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Appendix

Figure. 1. Saving energy system for 50-fluorescent lamps

Table 1. Calculation of saving energy for lighting system with 50 tubes.

Electrical energy per tube (W)	Electrical energy per tube (KW)	Number of tubes	Power consumption per hour (KW)	Power consumption per day (KW)	Power consumption per month (KW)	Power consumption per year (KW)	Electric bill VND/KW	Amount of money paid per year	Maximum saving money if TKD-N50 installed	TKD-N50's price (VND)	Payback time (year)
40	0.04	50	2	20	440	4.400	1252	5.508.800	2.754.400	4,000,000	1.45

Note: Assume that the lighting system runs for 10h per day, 22 days per month, and 10 months per year.