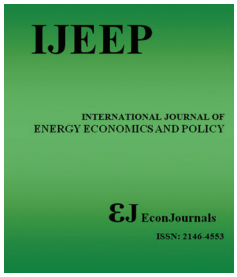

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Barriers to Energy Saving for Public Middle Schools in Bangkok: From School Management Perspective

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ABSTRACT

The Government sector is one of the main energy consuming sectors in Thailand which consumed 2,064 GWh of total consumption in 2012. Due to Thailand need to import energy, so Government of Thailand announced to all government agencies to reduce energy consumption by 10%. Public school is one of government agencies, not only to reduce their consumption but also have responsibility to transfer knowledge and create the behavior of energy saving for students. However, it is not simple to fulfill this task due to many obstacles, called "Barriers." The purpose of this paper is to identified the barriers which prevented public schools from energy saving and how to overcome those barriers, by interviewing with school managements as research method. The results highlight the government policies and values are the main barriers of energy saving in schools and also suggested various ideas of how to overcome those barriers in each level.

Keywords: Energy Saving, Barriers, Public School
JEL Classifications: Q4, P28

1. INTRODUCTION

In today world, energy is playing a very crucial role. Many parts of society such as household, industry, agriculture and transportation rely on energy in order to support life style and production of people. Most of energy is produced from fossils such as oil, coal and gas. Based on the energy reserve survey and current consumption ratio, it is estimated that the world has oil reserve for 25 years (EIA, 2013).

So energy saving is a very important issue that people around the world recognize. In Thailand, power saving is also an important issue for Thai government since it has to import energy from neighbor countries such as Laos and Myanmar more than 10,682 Million Kwh (DEDE, 2011) each year. According to Thai cabinet resolution announced on 19 Febuary 2013, Thai government sets goal for all government agencies to reduce energy consumption by 10% from 1,881 GWh of total energy consumption in year 2015 (EPPO, 2015). Public school, being one of the government agencies, is also affected from this policy. However, the results from Energy Consumption Reduction in Government Sector Project operated by Ministry of Energy showed that many government sectors were not aware and followed. Many even failed the key performance indicator (KPI) energy saving standard.

This paper studies and investigates energy saving by using public middle schools in Bangkok as case studies. Bangkok as the capital city of Thailand is chosen as an investigation site because it consumes 44,191 GWh per year (DEDE, 2011) which is highest in the country. Therefore it is significant that the buildings in Bangkok reduce its energy consumption. In addition, the number of extra-large size public middle schools in Bangkok is also the highest, totally 44 schools, while Nakhon Ratchasima province comes second with only 11 schools. However, the reason why each public middle school cannot reach the goal from Thai government is due to the energy efficiency barriers which prevent the schools from using energy efficiently and reducing energy consumption. In order to find the solution to overcome those barriers in the future, it is important to identify and understand key barriers that have obstructed them from energy saving and energy efficiency currently.

2. LITERATURE REVIEW

2.1. Overview of Bangkok and Education System in Thailand

2.1.1. General characteristics of Bangkok

Bangkok is located in the central part of Thailand on the low level plain of the Chao Phraya River which is the most important river in the country. Bangkok official location is at latitude 13.45 north and longitude 100.28 easts which is the tropical area of the world.

Bangkok has a monsoon type of climate, which can be classified into three main seasons: Rainy (May-October) winter (November-January) and summer (February-April). The average annual temperature was 29.2°C. In year 2015, Bangkok has a population about 5,715,486 and population density about 3.625 people per km^2. Bangkok is the 1st rank in terms of energy consumption in Thailand (DEDE, 2011).

2.1.2. Educational system

The Ministry of Education of Thailand divided the public education into 3 levels; primary, middle and higher education. It also takes responsibility and controls only primary and middle school. Thai students need to study in primary school for 6 years followed by 3 years in junior and 3 years in senior middle school. In addition, Thai government has regulation to enforce Thai people to have education until senior middle school for a total of 12 years. Bangkok has total 1504 institutes and more than 2.1 million students in its area (MOE, 2012).

2.2. Classification of Barriers

A study from Weber (1997) mentioned that the reasons for the energy efficiency gap are from certain barriers. Later Sorrell (2000) and SPRU (2000) described the definition of barrier as "a postulated mechanism that inhibits investment in technologies that are both energy efficient and economically efficient."

From the literature review, various researchers had categorized barriers into groups in order to understand their natures. This enabled them to conveniently analyze and find ways to overcome. Weber (1997) suggested 4 groups of barriers: (1) Institutional barriers caused by political institution such as government, (2) obstacles conditioned by market which can be referred as market failure, (3) organizational barriers occurred within organization, (4) Behavioral barriers occurred inside individuals.

In 2000, Sorrell studied many theories from economics, psychology and organizations. He proposed taxonomy of barriers in 3 groups: (1) Economical which is further divided into 2 sub-groups, i.e. (i) Rational which is related to cost, capital or risk, and (ii) market failure which are barriers from product marketing such as lack of information, (2) behavioral referred to barriers from individuals such as awareness or trust, (3) organizational which came from within each organization such as responsibility, culture or regulation.

Nagesha and Balachandra in 2006 studied the energy efficiency in small industry clusters and separated barriers into 5 groups as: (1) Awareness and information barriers which are about the lack of awareness from incomplete information, (2) financial and economic barrier that relate to obstacles from economic factors such as cost and investment, (3) structural and institutional barrier occurred by inadequate social and economic infrastructural facilities which result in low awareness, (4) policy and regulatory barrier that come from Government and local authorities, (5) behavioral and personal barrier from individuals such as resistant to change.

In 2008, Sardianou studied the energy efficiency investment in Greece and classified 4 groups of barriers which as similar to Sorrell's taxonomy, i.e. (1) financial barrier, (2) market barrier, (3) organizational barrier and (4) human factor barrier. However, in the same year, Schleich and Gruber (2008) reviewed literature on barriers and identified 5 groups of barriers in commerce and the services sector in Germany as: (1) Information and other transaction costs refers to lack of information measuring and cost to measure, (2) bounded rationality refers to routines or rules of thumb, (3) Capital constraints refers to barriers related to investment, access to capital and payback, (4) Uncertainty and risk, for example, uncertainty of energy prices or risk of unprofitable, (5) Investor/user dilemma related to split incentives between tenant and landlord (user and investor).

However, OECD Report (2011) which collected results from many researches in many countries, categorized barriers into 5 groups, (1) market refers to split incentive or transaction cost, (2) financial related to up-front cost, risky and complicated from investment, (3) information and awareness, such as lack of understanding or rational consumption, (4) regulatory and Institutional which affected from energy tariff or inappropriate support from institutes, (5) technical refers to lack of technology in local condition or insufficient capacity to implement and maintain energy efficiency investment.

After reviewing many researches regarding to barrier categories, similar concepts will be grouped together and listed in Table 1.

From Table 1, various studies on barriers to energy sufficient were further reviewed in many specifics areas such as theoretical economic, country-specific and industry clusters.

Table 1: Classification of barriers from literature reviews

Category	References
Economic: Financial	Sorrell, 2000; Nagesha and Balachandra, 2006; Sardianou, 2008; Schleich and Gruber, 2008; OECD, 2011
Economic: Market failure	Weber, 1997; Sorrell, 2000; Nagetha and Balachandra, 2006; Sardianou, 2008; Schleich and Gruber, 2008; OECD, 2011
Institutional	Weber, 1997; Nagetha and Bebchandra, 2004; OECD, 2011
Organizational	Weber, 1997; Sorrell, 2000; Sardianou, 2008; OECD, 2011
Behavioral and personal	Weber, 1997; Sorrell, 2000; Nagetha and Bebchandra, 2004; Sardianou, 2008; Schleich and Gruber, 2008

From theoretical economic, Brown (2001) studied the energy efficiency gap and barriers due to economic. He found that the market failures which are conditions of market that violate one or more of the neoclassical economic assumptions can be caused by, (1) misplaced incentives; (2) distorted fiscal and regulatory policies; (3) un-priced cost, (4) un-priced goods and (5) insufficient and incorrect information. He also mentioned the market barriers which refer to obstacles that are not based on market failures. These include: (1) Low priority of energy issues, (2) capital market barriers and (3) incomplete markets for energy efficiency.

From country-specific researches, de Groot et al. (2001) studied about energy saving barriers in 135 Dutch companies. They found that the most important barrier is from financial matters such as other investment is more important, energy cost is not significant, low priority of energy issue, limited budget, limited access to capital, uncertainty of price, insufficient and inaccurate information, lack of measuring of existing technology, etc. Later Sardianou (2008) studied the barrier in energy efficiency investment in Greece and identified many barriers such as financial constraints, bureaucratic problems, uncertainty about future energy price, lack of information, etc. In China, Wang et al. (2008) investigated various regions within China about barriers hindering the energy-saving programs. He listed that the dominant barriers are lack of awareness, limited policy framework, lack of incentives, lack of funding, lack of trained manpower, inadequate data and information.

In cluster and industry level, many researches were reviewed as well. Nagesha and Balachandra (2006) studied the analytic hierarchy process in order to find barriers to energy efficiency. The result from questionnaires showed that the financial and economic barriers such as lack of investment capability, lack of time/other priorities have the most effect to energy efficiency. The second most is behavior and personal barrier which concern resistant to change and lack of enforcement. Other types of barrier were also investigated such as lack of accurate information. These barriers will be later arranged in a table form. A year later Rohdin and Thollander (2006) studied by interviewing 8 companies of non-energy intensive manufacturing industry in Sweden. The results from this study highlights a number of factors that inhibit energy efficiency such as cost and risk, lack of time and priority issues and lack of sub-metering in large organization, etc.

Some researches were also reviewed for barriers in educational institute. Sorrell (2000) studied the energy efficiency barriers of universities in 3 countries; UK, Germany and Ireland. In UK, the top 5 barriers considered of high importance are access to capital, hidden cost, risk, inadequate information and split incentives. In Germany, the barriers are similar but differ in ranking. They are access to capital, hidden cost, incomplete information and split incentives. Irish universities also have different ranking which are; access to capital, hidden cost, imperfect information, split incentives, principal-agent relationship. Kershaw and Simm (2014) studied barriers to low carbon school design in UK from design team perspective. The results of their research identified the important barriers such as legislation, environmental concerns, running cost. There were also barriers from school structure itself such as increased equipment in modern schools, complexity of building system and extra cost for design and technology.

Literatures for barriers in Thailand were also reviewed. The United Nations Environment Program (UNEP, 2006) published a report about finding strategies to prevent wastes and emissions and assisting companies in Asia and Pacific to improve energy efficiency. Nine Asian countries: Bangladesh, China, India, Indonesia, Mongolia, Philippines, Sri Lanka, Thailand and Vietnam participated in this program. The result shown key barriers of Thailand in terms of Management, Knowledge and information, Financing and Policy were Low priorities of energy issue from management, lack of time to improve energy efficiency, lack of awareness for energy and environment issues, lack of technologies and skills, subsidization of energy, risk of investment and lack of coordination between external organizations. Hasanbeigi et al. (2010) investigated barriers for energy efficiency in both textile and cement industries by collecting data from questionnaires and using semi-structure interviews to collect expert opinion from various institutes. They found the key barriers as follows; lack of financial resources, extra cost from improving energy efficiency, low priority for energy efficiency, risk from uncertainty, lack of management support, incomplete information, lack of knowledge, split incentives, lack of government support, lack of coordination between external organization, lack of enforcement of government regulation. After the various researches in many perspectives were reviewed, similarity and difference of barriers are listed in Table 2 according to each category.

3. RESEARCH METHODS

This paper uses semi-structured interview as research method to gather information of practice and personal opinions. The experts from each case study were interviewed to provide detailed information to ensure that all information in each topic is collected completely to allow accurate analysis. This semi-structured interview is a well-proven scientific methodology to do a qualitative research (Patton, 2002) and has been used in some other studies on barriers to energy efficiency such as du Pont (1998), Rohdin and Thollander (2006). The case studies are selected based on criteria as below:

1. Position: All interviewees are experts who are at the top management of public middle schools and involve in school's policy regarding the energy management. In this research, 8 experts are deputy director and 2 experts are director.
2. Year of establishment: Older schools have more old building than newer schools. Their reputation is also higher than new ones. Hence they tend to have more students and budget from government.
3. Number of students: According to the Ministry of Education, school size will be categorized into 4 groups; small (<500 students), medium (500-1499 students), large (1500-2499 students) and extra large (2500 students and above). The number of students is directly related to number of energy users. More number of students means more energy consumption in schools.
4. Gender: Some public middle schools in Thailand accept only

Table 2: Category of barriers from literature reviews

Category	Typical barriers	References
Economic: Financial Sorrell (2000), Nagetha and Balachandra (2006) Sardianou (2008), Schleich and Gruber (2008), OECD (2011)	Hidden cost	Sorrell (2000), de Groot et al. (2001), Nagetha and Bebchandra (2004), Rohdin and Thollander (2006), Sardianou (2008), Kershaw and Simm (2014)
	Access to capital	Sorrell (2000), Brown (2001), de Groot et al. (2001), Nagetha and Bebchandra (2004), Rohdin and Tholander (2006), Sardianou (2008), Wang et al. (2008), Kershaw and Simm (2014)
	Risk	Sorrell (2000), de Groot et al. (2001), Nagetha and Balachandra (2006), Rohdin and Thollander (2006), Wang et al. (2008), Kershaw and Simm (2014)
	Time and priority	Sorrell (2000), Brown (2001), de Groot et al. (2001), Rohdin and Thollander (2006), Sardianou (2008), Wang et al. (2008), Kershaw and Simm (2014)
Economic: Market failure Weber (1997), Sorrell (2000), Nagetha and Balachandra (2006), Sardianou (2008), Schleich and Gruber (2008), OECD (2011)	Imperfect information	Sorrell (2000), Brown (2001), de Groot et al. (2001), Rohdin and Thollander (2006), Sardianou (2008), Wang et al. (2008), Kershaw and Simm (2014)
	Spit incentives	Sorrell (2000), Kershaw and Simm (2014)
	Principal-agent relationships/ Misplaced incentive	Sorrell (2000), Brown (2001), Rohdin and Thollander (2006)
	Lack of technology and technical skills	Sorrell (2000), Brown (2001), de Groot et al. (2001), Rohdin and Thobnder (2006), Sardianou (2008), Wang et al. (2008)
	Lack of traced manpower	Sorrell (2000), Brown (2001), Sardianou (2008), Wang et al. (2008)
	Complexity of design and structure	Sorrell (2000), Brown (2001), Wang et al. (2008), Kershaw and Simm (2014)
Institutional Weber (1997), Nagetha and Balachandra (2006), OECD (2011)	Distortionary fiscal and regulatory policies	Brown (2001), Nagetha and Balachandra (2006), Sardianou (2008)
	Incentive structure	de Groot et al. (2001), Nagetha and Bebchandra (2004), Wang et al. (2008)
	Public coordination program	Nagetha and Bebchandra (2004), Kershaw and Simm (2014), Wang et al. (2008)
Organizational Weber (1997), Sorrell (2000), Sardianou (2008), OECD (2011)	Poor purchasing process/procedure	Sorrell (2000), de Groot et al. (2001), Kershaw and Simm (2014)
	Lack of energy saving awareness	Sorrell (2000), Nagetha and Balachandra (2006), Rohdin and Tholander (2006), Wang et al. (2008), Kershaw and Simm (2014)
	Lack of management support	Sorrell (2000), Rohdin and Thollander (2006), Wang et al. (2008), Kershaw and Simm (2014)
Behavioral and personal Weber (1997), Sorrell (2000), Nagetha and Balachandra (2006), Sardianou (2008), Schleich and Gruber (2008)	Inertia/change resistant	Nagetha and Balachandra (2006), Sardianou (2008), Wang et al. (2008), Kershaw and Simm (2014)
	Values	Nagetha and Bebchandra (2004), Wang et al. (2008)

male or female students. In this research, sample schools which have only female were selected in order to find the differences of barriers between single gender schools and coeducation schools.

5. School class: Some public middle schools in Thailand provide education only at junior or senior levels. Since senior students can be easily trained to be aware about energy problems, sample schools which have only senior middle school students were selected in this work. All above information were collected and presented in Table 3 as below.

In our study, experts are the top administrators of selected middle public schools in Bangkok. They all have professional experiences in education and have been working in public schools more than 20 years. Many of them also have experiences with schools of different size and number of students. They are the persons who involve directly with the energy policy and practice in schools. It is important to address the barriers which obstruct energy saving in their schools from them and to understand their requirements in order to support the energy efficiency and saving. At the end of this research the result will be comprehensible and useful for them.

The same set of questions for all experts were categorized into 5 groups:

1. The profile of expert and school. Each expert was asked about personal and school information briefly such as background, position, number of buildings, number of classrooms, number of students, and number of staffs.
2. The current situation of energy consumption in school. Each expert was asked to give opinion about the energy consumption in school such as energy bill, consumption behavior of students and other staffs, energy network and installation, type and number of electronic devices in school.
3. The current energy policy and practice in school. Each expert was asked to give opinion about the energy policy and practice in school such as government policy which relates to energy saving in school, efficiency of electronic devices usage, renewable or alternative energy usage, school building renovation for energy efficiency, knowledge transfer of energy saving, energy saving campaign in school, the person or team who is responsible for energy saving in school and cooperation with external organization for energy saving in school.
4. The key barriers that obstruct energy efficiency and saving in school. Each expert was asked to give opinion about the current barriers or problem for energy saving in school such as access to capital, hidden cost, risk, incomplete information, split incentives, culture and power identified from literature reviews. This is the most important question to provide result for this paper.
5. The suggestions for energy saving in school in the future. Each expert was asked to give opinion about how to overcome the current barriers or problem for energy saving in school from their perspectives.

These responses are collected, analyzed and compared to find out the similarities and differences in terms of current situation, current barriers and problems and future suggestion. As a result, the key barriers of energy efficiency and saving in middle school will be identified as shown in Table 4 where barriers are ranked according to the number (in parenthesis) of interviewees who share the same opinion.

Table 3: Profile of case studies of public schools in Bangkok

School profile	School									
	1	2	3	4	5	6	7	8	9	10
Interview position	Deputy director	Deputy director	Deputy director	Deputy director	Deputy director	Deputy director	Deputy director	Deputy director	Director	Director
Established year	1951	1995	1901	1975	1955	1938	1992	1935	1980	1968
Number of student	3200	1600	3600	2000	3000	4500	2500	4200	800	4200
School type	Coeducation	Coeducation	Only female	Coeducation	Coeducation	Coeducation	Coeducation	Coeducation	Coeducation	Coeducation
Junior/senior high school	Both	Both	Both	Both	Both	High school	Both	Both	Both	Both

Table 4: Top 5 rankings of the key barriers derived from the interview with experts

Ranking (points)	Typical barriers	Comments
1 (9)	Distortionary fiscal and regulatory polices	Most public school in Bangkok are control by ministry of education, so almost every experts mentioned that the barrier from government policy is the most important key barer
1 (9)	Values	The life style and familiarity of today's student affected the value of environment and energy issue as fewer priority when compare to their our convenient and comfortable
2 (8)	Time and priority	Education is the most important priority of school, the other issues will be concerned later, So budget and time will be invested to project which related to education first
3 (6)	Principal-agent relationships/ misplaced incentive	Students and staffs n school do not have responsibly for energy bill, while schools need to pay instead. So it prevent student to save energy and school management to invest for energy saving
4 (5)	Imperfect information	Lack of information from energy situation in school, it is impossible for school management to find solution or issue policy for energy saving and efficiency
4 (5)	Complexity of design and structure	The age of building and related energy equipment prevent the schools from energy efficiency, while the modern school requirements are also increase the energy consumption
5 (4)	Access to capital	Difficulty to apply for external source for investment capital due to regulation, many public schools need to request budget from government or find the way to get more capital such as donation
5 (4)	Lack of trained manpower	Lack of sidled staff and too many workloads prevent the public schools from energy saving and efficiency
5 (4)	Poor purchases process/ procedure	The purchaser regulation which relied on price rather than functional or long tern benefit, and the replacement approval only after unusable are the obstacle of public schools for energy saving policy

4. KEY BARRIERS CONSIDERED OF HIGH IMPORTANCE IN PUBLIC SCHOOL IN BANGKOK

Distorted fiscal and regulatory policies:

1. This was considered the most important barrier obstructing the energy saving of schools mentioned by 9 from 10 of experts. This barrier is caused by the government policy and regulation related to energy including electricity in Thailand. Since all public schools are owned by the government, the school management staff must follow the ministry of education in its energy consumption policy. Unfortunately this policy has no clear objectives and is not easily practiced. Thus it is very difficult for school to respond and take action effectively. Although the Ministry of Energy has issued energy saving practice in year 2013, many school administrators said that they did not recognized them. Another point of the failure is due to lack of regulation control and enforcement by the government. Some schools mentioned that the problem may come from bureaucratic of the Thai government which has long chain of commands and lack of cooperation between each unit. So it is clear that government policy is the key barrier for energy saving and efficiency. This key factor is similar to the research of Brown (2001) and Sardianou (2008).
2. Values: This means the value that a person has about the energy saving and environment. A low value means that a person is not aware or gives very low priority. Such a value is usually reflected from personal behaviors, cultures or believes. From interviews, 9 from 10 experts mentioned this barrier as the most important barrier for public school in terms of energy saving and efficiency, i.e. it ranks first as Distortionary fiscal and regulatory policies. They said that the life style of people nowadays is different, especially for students. Most students prefer the convenient lifestyle with many electronic gadgets such as mobile phone, table and etc. For example at home they live comfortably in a cool environment by using air-con also the devices and prefer to have the same comfort at school. So they will use light and a cooling system in classroom without caring about the excessive energy consumption. Even when someone point out this issue, they are willing to pay the energy bill by themselves or their parents. This means they value personal comfort higher than the environment and energy saving and efficiency. Furthermore, some experts mentioned that students and their parents give the first priority to scores and will not concern with energy saving and efficiency because it is not related. This value of behavioral as a key barrier is the same result with the research carried out by Nagesha and Balachandra (2006).
3. Time and priority: This barrier was tabulated by experts as the second rank. 8 out of 10 experts said that the school needs to spend budget to projects related to education first since the primary goal of school is to provide education. So the energy saving project will be considered as lower priority and was sometime neglected from public schools. Without using efficient equipment's or devices, it is difficult for schools to carry out energy saving projects. Some experts mentioned about the LED lighting which has better performance and energy saving when compared to normal light bulbs. However, LED lamp replacement will not be feasible in the next few years since its cost is high. Hence most of school budget are allocated to other projects that have direct impact to education and school performance such as lecturer training and classroom maintenance. The research from de Groot et al. (2001) and Rohdin and Thollander (2006) also indicate the same result as key barrier.
4. Principal-agent relationships/misplaced incentive considered third in ranking the key barrier. 6 out of 10 school administrators said the students and staffs have no responsibility to pay for energy bill so they do not care much about their energy consumption behavior. This energy bill is absorbed by government budget. Because of this, it is difficult for school to control and reduce the energy consumption of users. It also seriously affects the decision making of school management to invest in energy saving project. This observation coincides with the research of Sorrell (2000) which mentioned Principal-agent relationships as key barrier from Irish higher education.
5. Incomplete information considered as a key barrier from 5 out of 10 experts and is thus ranked fourth among those key barriers pointed out from them. While few experts said that their schools have the records of energy consumption by times, by building, by room etc., many experts admitted that they do not have detailed records of energy consumption other than the information of monthly energy bill. Such non-detailed information prohibits them to figure out which building or room consumes more energy than others and why. Without completed information, the school management cannot find the root of energy waste and solve it efficiently. Furthermore few experts said that it is difficult to justify an investment for energy efficiency unless a comparison plan of energy consumption between before and after investment can be made. Hence the investment proposal is not strong enough to get budget approval. The same result is also pointed out by Rohdin and Thollander (2006) and Sardianou (2008) who mentioned that incomplete information is the key barrier of energy saving.
6. Complexity of design and structure: This barrier was ranked 4th as 5 from 10 experts mentioned this barrier during the interviews. This barrier stems from the design and requirement of schools. Some schools have old buildings that pose many problems for energy saving. There are many buildings that were built more than 50 years during which energy saving is not of much concern as it is today. So the layout of classroom, the electricity network and many other infra-structure in the buildings were built without concerning of the energy saving but only the simple of use for users and installer, some experts give example of the electricity network of lighting, in many classroom only 1 on-off switch to control all lighting bulb in classroom, that's mean in case only few students want to do their homework before go back home, all the lighting bulb in the classroom will be opened instead of few bulbs if the on-off switch were separated. In addition, some experts said that the energy requirements of classrooms are not the same as before, many devices were used such as microphone, projector, computer, electric fan, lighting bulb and air cooler,

especially air cooler will be increasingly used in schools due to the rising temperature in Bangkok every year. So it is difficult for school to perform energy saving and efficiency under this circumstances. The research from Kershaw and Simm (2014) provided the same result that the complexity of design and structure is one of the key barrier for energy saving.

7. Access to capital ranks 5 from the list with 4 out of 10 interviewees mentioning. Public schools operate mostly from government budget with a few receiving incomes from donation and extra fee for special classrooms. Therefore most of the received budget will be used mainly for education and related project. Investment in energy saving and efficiency is not related to education and thus has a low priority. Frequently there is not enough budge for education. Therefore, if energy saving is to be invested, the budget must be derived from special program or donation which is difficult for small or less famous schools. One popular program that famous schools can organize in order to gather extra fee is an international program. This kind of program can be successfully organized only by famous schools. This key barrier is also mentioned by Sorrell (2000) and Wang et al. (2008).
8. Lack of trained manpower. This barrier ranks 5 as 4 from 10 experts mentioned it during the interview. In some schools it is very hard to find qualified staff that has a skill to operate and manage energy devices. Many schools assign janitors not just for cleaning but for maintaining electricity cables and devices, water supply system, gardening and etc. They are certainly not qualified for electricity management task. In addition, school lecturers are reluctant to participate in energy saving since they are already occupied to focus on classroom lecture, examination and other educational activities. With no trained person, energy saving is not easy to operate successfully. This finding is the same as Wang et al. (2008) and Sardianou (2008).
9. Poor purchasing procedure: This barrier was mentioned by 4 from 10 interviewees and also ranked as number 5. Due to strict control of the government regulation, device purchasing cannot be performed unless existing one is deformed. Thus replacement just for the sake of saving energy or increasing efficiency is not acceptable. Price, not functional or capacity, is also an important factor enforced by the regulation. This prevents the schools to try new devices, such as LED lamps, just for saving energy. If a school really wants to purchase such equipment or device, the purchasing officer has to prepare the document to show comparison or benefit. This takes a lot of time and inconvenient so the purchasing officer would normally select the lowest price instead of higher performance in order to avoid extra work load and problem which may happen later. This barrier is also mentioned from the research of Kershaw and Simm (2014) as one of the important barrier to prevent energy efficiency.

5. SUGGESTION FROM EXPERTS FOR ENERGY SAVING IN PUBLIC MIDDLE SCHOOLS IN BANGKOK

From the interview, many experts mentioned about how to overcome the barriers of energy saving and efficiency in public schools. Their suggestions can be separated by sector as followed.

5.1. National Level

Policy recommendations at the national level include the following:

- Awareness: Thai government has to recognize the energy problem as a national issue in order to stimulate not only the government but also private sectors to increase their awareness about energy saving. The government campaign for energy saving must be established with clear objectives, long and short term goal. It must be continuously promoted to build up awareness of Thai people. If succeed, it will change energy consumption behavior of both student and staff in schools. Increase awareness and value of environment and the energy saving in school will be accomplished obviously.
- Incentive: Government should provide incentives to encourage energy saving in schools. Monetary related incentive is recommended. For public schools, the reward should be provided to the school that can reduce energy consumption level by level such as increasing budget. The school managements can also get reward if their schools can meet target of energy saving, while they will get warning or punishment if their schools have poor performance for energy saving. The incentive policy must be stated clearly for every office, departments in government sector.
- Cooperation: Government has to establish the cooperation between 4 organizations that play a crucial role for energy in Thailand. The first is the Ministry of Energy who takes care of energy policy and regulation. The second is Electricity Generating Authority of Thailand who takes care of electricity generation. The third is Metropolitan Electricity Authority who takes care of electricity distribution in Bangkok and surrounding areas. The fourth is Provincial Electricity Authority who takes care of electricity distribution in other provinces of Thailand. These organizations can support public schools in terms of energy saving by providing skilled persons who can consult to school managements and provide knowledge to both students and staffs. In addition, these organizations can also provide efficient equipments or devices to help schools for their energy saving task, particularly those schools which have limited budget. The cooperation must be established and maintained continuously. Otherwise, the energy saving campaign in public schools will be difficult to perform successfully.

5.2. School Level

Policy recommendations at the school level include the following:

- Support from school management: It is important for the school managements such as director or deputy director to pay attention and follow government objectives accordingly by issuing the policy and practices to support energy saving. They also need to give energy saving issue as top priority in school so they can allocate budget to support the energy saving policy efficiently.
- Energy saving campaign: A campaign must be established in public schools and everybody in the school has to participate. Objectives must be clearly explained and evaluated. Benefit or reward should be given to anyone who passes evaluation or

wins the competition during the campaign. The benefit should be linked to education record for students such as giving extra score in some subjects. By the same reason, the benefit should be linked to KPI for staffs in schools. The energy saving campaign must be continuously promoted in schools in order to increase the chance of energy saving behavior of students and staffs.

- Energy champion and team: Public schools should set up an energy team and champion to monitor and encourage everybody in schools for energy saving. The team shall be recruited from voluntary students who have energy awareness and are willing to help schools to achieve energy saving goal, while the champion shall be one of the school management team appointed and authorized from directors to find ways to promote energy saving.

5.3. Household Level

Policy recommendations at the household level include the following:

- Behavior: Every family should create energy awareness and behavior to their children since childhood rather than expect them to have the energy awareness while they study in school. Most students spend time in school <8 h while staying at home more than 12 h per day in average. So the parents can play an important role to educate their children in terms of energy saving rather than relying only on the school. In addition the large number of teacher and students ratio is usually high while the parent can teach their children individually at home.

6. CONCLUSION

This paper illustrates the key barriers to energy saving in public schools within Bangkok area and provides opinions from experts to overcome them. Results of the case studies in public school show that the management concern about the distorted fiscal and regulatory policies and values as the most important key barriers which obstruct the public school from energy saving. However, more research is required to investigate about it in the future since the relationship between the public school and government is different from other organizations. Public schools in Thailand are controlled by Thai government. Government policy directly affects the school management point of view in the sense that its policy prevents the schools from energy saving. This policy should be changed and the government should take more action in order to support public school for energy saving. Some schools strongly believe that time and priority is also the important key barriers too. However, this barrier is somehow related to the distorted fiscal and regulatory policies. In any case schools need to provide education as the first priority but the priority of energy issue should be raised by government too. Then the schools can invest more time, work force and budget for energy saving projects. The misplaced incentive is also concerned from some schools as another hi-rank barrier which prevents energy saving. Another risky point in the investment for energy saving project in schools is due to the fact that reduction of energy consumption must rely on the students and staffs who do not have responsibility for energy bill and investment.

Finally, this study presents suggestions about how to overcome the key barriers which obstruct public schools in Bangkok from energy saving and efficiency. These suggestions are separated into 3 levels. The national level concerns about the government regulation and policy. The school level concerns about the school policy and management and the household level which concerns about the household energy consumption behavior. These suggestions are discussed as the important steps to help not only the public schools to perform energy saving and efficiency but also related sectors as well. However, this paper also has 3 limitations. The selected schools are located only in Bangkok and the type of school is limited to middle schools. The last limitation is that only school management is interviewed for opinion without any input from staffs and students. So the future research is required to investigate more for the missing gap which this paper does not provided.

REFERENCES

Brown, M.A. (2001), Market failures and barriers as a basis for clean energy policies. Energy Policy, 29(14), 1197-1207.

Department of Alternative Energy Development and Efficiency, (DEDE), (2011), The Annual Report, Electric Power in Thailand 2011, Bangkok, Published by Alternative Energy and Efficiency Information Center, Department of Alternative Energy Development and Efficiency.

de Groot, H., Verhoef, E., Nijkamp, P. (2001), Energy saving by firms: Decision-making, barriers and policies. Energy Economics, 23(6), 717-740.

du Pont, P.T. (1998), Energy Policy and Consumer Reality: The Role of Energy in the Purchase of Household Appliances in the US and Thailand. Doctoral Thesis. USA: University of Delaware.

Energy Policy and Planning Office, (EPPO). (2015), The Energy Use Intensity (EUI) Book 2559, Energy Policy and Planning Office, Ministry of Energy. Available from: http://www.e-report.energy.go.th/kpi59m_files/PDF_EUIBOOK2559.pdf. [Last accessed on 2013 Apr 15].

Hasanbeigi, A., Menke, C., du Pont, P. (2010), Barriers to energy efficiency improvement and decision-making behavior in Thai industry. Energy Efficiency, 3(1), 33-52.

Kershaw, T.J., Simm, S. (2014), Thoughts of a design team: Barriers to low carbon school design. Sustainable Cities and Society, 11, 40-47.

Ministry of Education, (MOE). (2012), 2012 Educational Statistics in Brief, Bangkok, Office of the Permanent Secretary, Ministry of Education, Government of Thailand.

Nagesha, N., Balachandra, P. (2006), Barriers to energy efficiency in small industry clusters: Multi-criteria-based prioritization using the analytic hierarchy process. Energy, 31(12), 1969-1983.

OECD. (2011), OECD Green Growth Studies: Energy, OECD. Publishing, Organisation for Economic Co-Operation and Development. Available from: http://www.oecd.org/greengrowth/greening-energy/49157219.pdf. [Last accessed 2015 Nov 30].

Patton, M.Q. (2002), Qualitative Research and Evaluation Methods. 3rd ed. London: Sage.

Rohdin, P., Thollander, P. (2006), Barriers to and driving forces for energy efficiency in the non-energy-intensive manufacturing industry in Sweden. Energy, 31(12), 1836-1844.

Sardianou, E. (2008), Barriers to industrial energy efficiency investment in Greece, Journal of Cleaner Production, 16(13), 1416-1423.

Schleich, J., Gruber, E. (2008), Beyond case studies: Barriers to energy efficiency in commerce and the services sector. Energy Economics, 30(2), 187-208.

Sorrell, S. (2000), Barriers to energy efficiency in the UK higher education sector, (Report Prepared For the EU Project Barriers to Energy Efficiency in Private and Public Organizations), Brighton. Science and Technology Policy Research (SPRU), Sussex University.

UNEP, (United Nations Environment Programme). (2006), Barriers to Energy Efficiency in Industry in Asia-Review and Policy Guidance. Available from: http://www.energyefficiencyasia.org/brochure_pub.html. [Last accessed on 2015 Nov 30].

U.S. Energy Information Administration, (EIA). (2013), The Annual Energy Outlook 2013. Washington, DC: Office of Integrated and International Energy Analysis, U.S. Department of Energy.

Wang, G., Wang, Y., Zhao, T. (2008), Analysis of interactions among the barriers to energy saving in China. Energy Policy, 36(6), 1879-1889.

Weber, L. (1997), Some reflections on barriers to the efficient use of energy. Energy Policy, 25(10), 833-835.