

CHAPTER TWO

REVIEW OF THE LITERATURE

This chapter reviews the literature on related theories and concepts, and previous research and studies.

- 2.1 Theory and concept of knowledge
 - 2.1.1 Definition of knowledge
 - 2.1.2 Concept of knowledge
 - 2.1.3 Levels of knowledge
 - 2.1.4 Types of knowledge
 - 2.1.5 The knowledge measurement
- 2.2 The concept of Demand Side Management (DSM) program in Thailand
 - 2.2.1 Overview
 - 2.2.2 The concept of “AAA”
 - 2.2.3 Operating Performance
- 2.3 The Concept of general electricity energy saving
 - 2.3.1 The important things that we should consider before choosing electrical equipment
 - 2.3.2 Units of electricity
 - 2.3.3 Electrical Equipment
- 2.4 Related Studies

2.1 THEORY AND CONCEPT OF KNOWLEDGE

2.1.1 Definition of Knowledge

The definition of knowledge varies from person to person, but it shares similar aspects. According to Saisunee Pavuttinun, 1998, pp.28, knowledge is facts, information, details of story and experience perceived by humans. It can be concluded that knowledge is the ability to remember and understand the details of information in many aspects such as an event, a person, and a rule which a person can accumulate and recall and which can be measured (Pimjai Saivipoo, 1998, pp.9).

According to Jumnean Maipiya, 2000, pp.22, knowledge is the perception of facts, rules, and stories related to specific or general things that a human perceives and the perception has to be clear and take time. Onyanee Suntarat, 2003, pp.31 cited in

Sunan Kungosum, defined knowledge as the ability to maintain facts, details of stories, and experience of students.

2.1.2 Concept of Knowledge

Labor and management who have knowledge are the key factors of production. Therefore, if the persons have the opportunity to develop their knowledge continuously, it will support competitive potential (Jittakorn Tungkaseamsuk, 2000, pp.228 citing in Drucker).

According to Onyanee Suntarat, 2003, pp.33 cited in Thean Vivitsiri, learning in adults occurs by three experiences:

1. *Natural Setting* is the learning from nature around them.
2. *Society Setting* is in our daily life such as learning from reading newspapers and watching television.
3. *Formal Institutional Setting* is learning from an institute's tutors that arrange the learning process with specific goals.

Therefore, the acquisition of knowledge at all levels has a relationship with the consciousness resulted from the accumulated experiences.

2.1.3 Levels of Knowledge

Knowledge is wisdom that consists of knowledge, ability, and skills of the brain. It can be classified into 6 levels (Anun Srisopa, 1977, pp.13-14).

1. Knowledge : the memory of experience
 - 1.1 Knowledge of content
 - 1.1.1 Knowledge of meaning
 - 1.1.2 Knowledge of facts such as time, event, person, place, source, etc.
 - 1.2 Knowledge of methods and processes of specific things
 - 1.2.1 Knowledge of tradition
 - 1.2.2 Knowledge of trend and order
 - 1.2.3 Knowledge of classification
 - 1.2.4 Knowledge of rule and process
 - 1.3 Knowledge of the collection of concept and structure

1.3.1 Knowledge of rules and how to use them to value, forecast, or interpret the meaning of what we see

1.3.2 Knowledge of theory and structure

2. Comprehension : the understanding of meaning

2.1 Translation (translate with the original meaning kept)

2.2 Interpretation (explaining or rearranging the content to facilitate understanding)

2.3 Expansion (expand the meaning of information)

3. Application: the ability to use knowledge or the ability to solve problems.

4. Analysis : classifying the story into subparts

4.1 Analyzing the components

4.2 Analyzing the relationship of the components

4.3 Analyzing the method to combine the components

5. Synthesis : combining the components

5.1 The manner that shows the meaning

5.2 The manner related to plans or proposals

5.3 The development of relationship in the components.

6. Evaluation : assessing the value of target things by using a certain rule

6.1 Assessing by internal circumstance

6.2 Assessing by external circumstance

2.1.4 Types of Knowledge

According to Tawatchai Chaijarichayakun, 1984, pp.20-24 citing in Bloom, knowledge has 3 stages:

1. *Knowledge of Specifics* is the memory stage of the specific thing or part of a single substance.

1.1 *Knowledge of Terminology* is the knowledge of specific symbols (language and non-language) including acceptable knowledge of symbols, knowledge of various kinds of symbols which may be used only one time.

1.2 *Knowledge of Specific facts* is the knowledge about date, event, person, and place, etc. which may include accurate and specific information

such as the exact date or detail of the events. It may include quantity information such as a period of time, order and the importance of events.

2. *Knowledge of Ways and Means to Deal with Specifics* is the knowledge of the way to manage education to make decisions and criticisms.

2.1 *Knowledge of Conventions* is the knowledge of the way to perform and present ideas and events to convey their meaning. It is created from a group or is a result of an individual experience.

2.2 *Knowledge of Trends and Specifics* is the knowledge of progress, direction and movement of events related to time.

2.3 *Knowledge of Classification and Categories* is the knowledge of levels, sets, sections, and their arrangement.

2.4 *Knowledge of Criteria* is the knowledge of facts, concepts, opinions, and operations which have been tested or judged.

2.5 *Knowledge of Methodology* is the knowledge of investigating techniques and processes used in solving problems.

3. *Knowledge of Universals and Abstractions* is the knowledge of important plans or formats that organise phenomena and opinions.

3.1 *Knowledge of Principles and Generalizations* is the knowledge used to summarize abstract phenomena that is used to explain, forecast, or determine the proper direction of actions.

3.2 *Knowledge of Theories and Structures* is the knowledge of principles and general conclusions including the relationships between them which clearly show the picture of event and problem.

2.1.5 The Knowledge Measurement

Sumalee Chunchalaw, 1999, pp.54-69 cited in Anun Srisopa, 1977, pp.13-14 defined the tests based on the concept of 6 stages of knowledge structure as:

1. *The method to measure knowledge and memory.* This uses questions to test recall of a specific or general thing. The questions used in this stage measure the memory of content, process, and comprehension.

2. ***The method to measure understanding.*** Questions are not directly based on texts but the application of the texts. For example, the questions measure translation, interpretation, and expansion abilities.

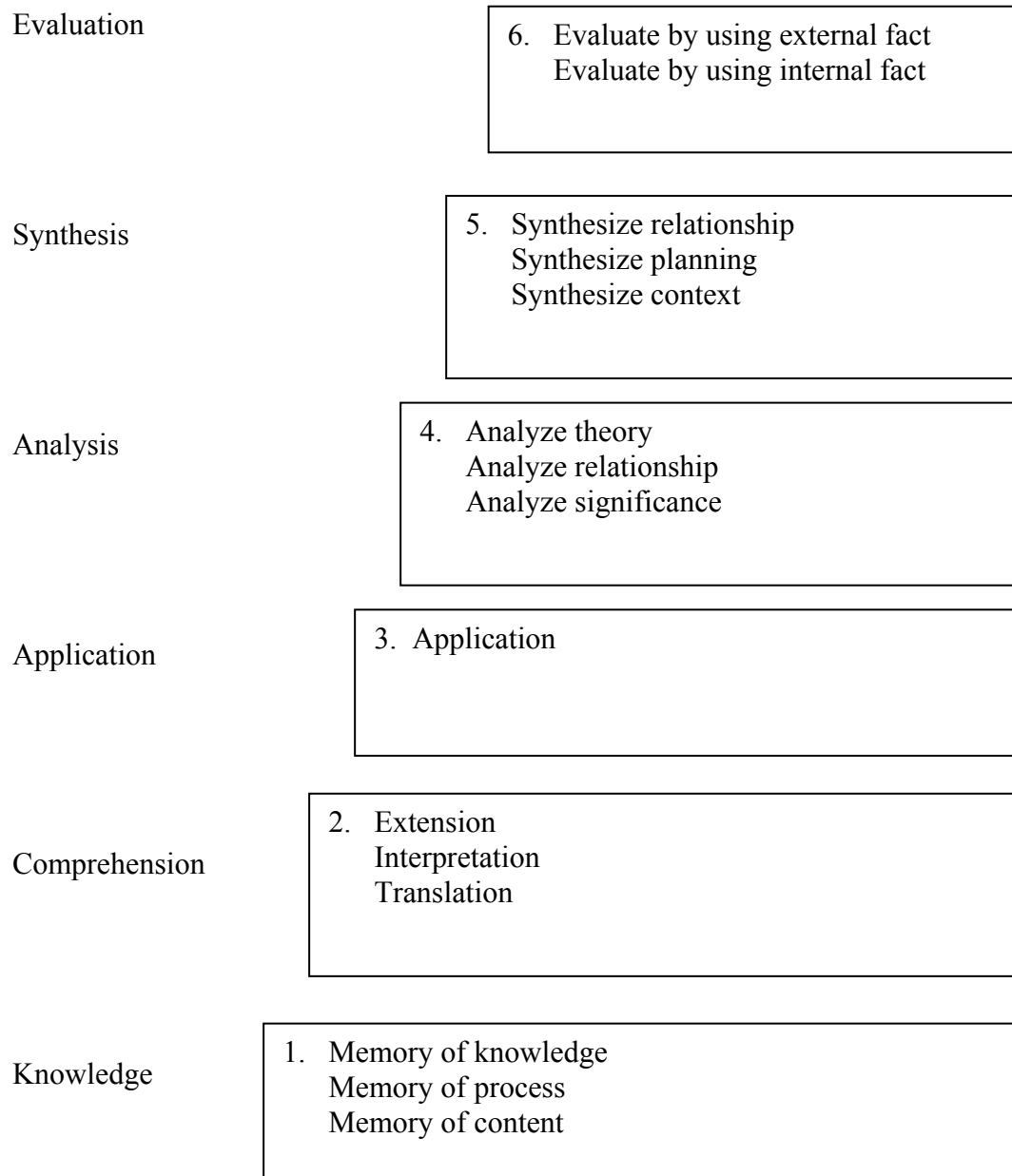
3. ***The method to measure application.*** This measures the ability to apply knowledge and understanding of problems in any circumstances.

4. ***The method to measure analysis.*** This measures the ability to classify details of stories, thoughts, and operations into subparts by using rules and principles.

5. ***The method to measure synthesis.*** This measures the ability to collect and integrate details of information to create new and different things.

6. ***The method to measure evaluation.*** This measures the ability to evaluate a story, thought, or behavior.

Six stages of knowledge measurement



Showing the measurement of knowledge according to the aspects of knowledge and thought by Bloom and associates

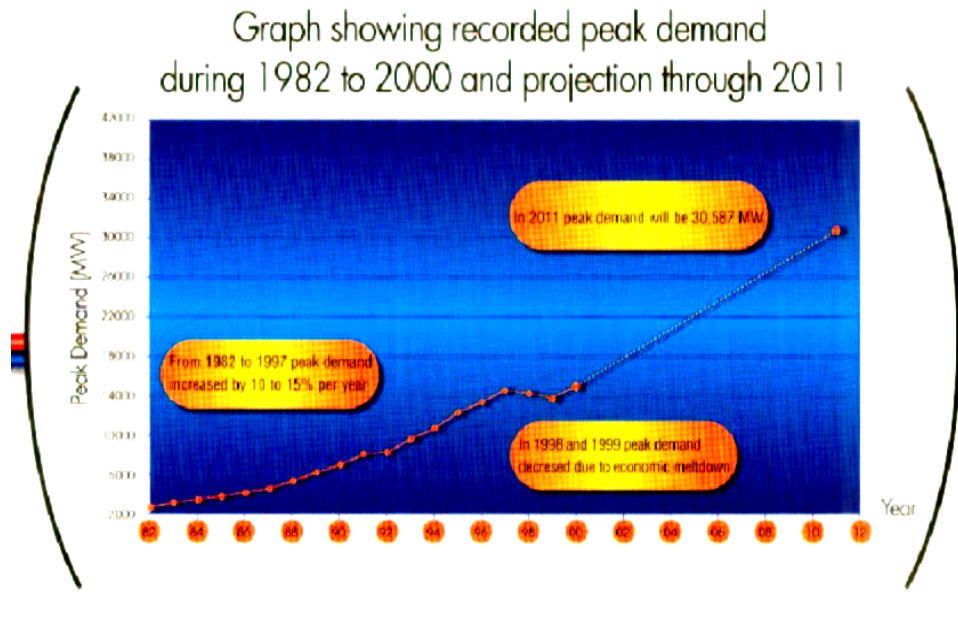
From *The human memory: Theory and teaching technique* (pp.119), by Sawai Leamkeaw, 1985, Bangkok: Mitsiam.

2.2 THE CONCEPT OF THE DEMAND SIDE MANAGEMENT (DSM) PROGRAM IN THAILAND

On December 3, 1991 the government approved the establishment of the Demand Side Management Project (DSM) as a new department in EGAT. Meanwhile, the Metropolitan Electricity Authority (MEA) and the Provincial Electricity Authority (PEA) were also assigned to provide close cooperation and assistance. The initial program appeared on September 20, 1993 under the slogan “Together in Conservation” which joined with the 109th anniversary of the first light bulb in Thailand. The objectives of this program are the reduction of national energy consumption, peak demand, imported fuel, resource consumption, consumers’ power bills, and the reduced emission of CO₂ into the atmosphere (Singh and Mulholland, 2000).

2.2.1 Overview

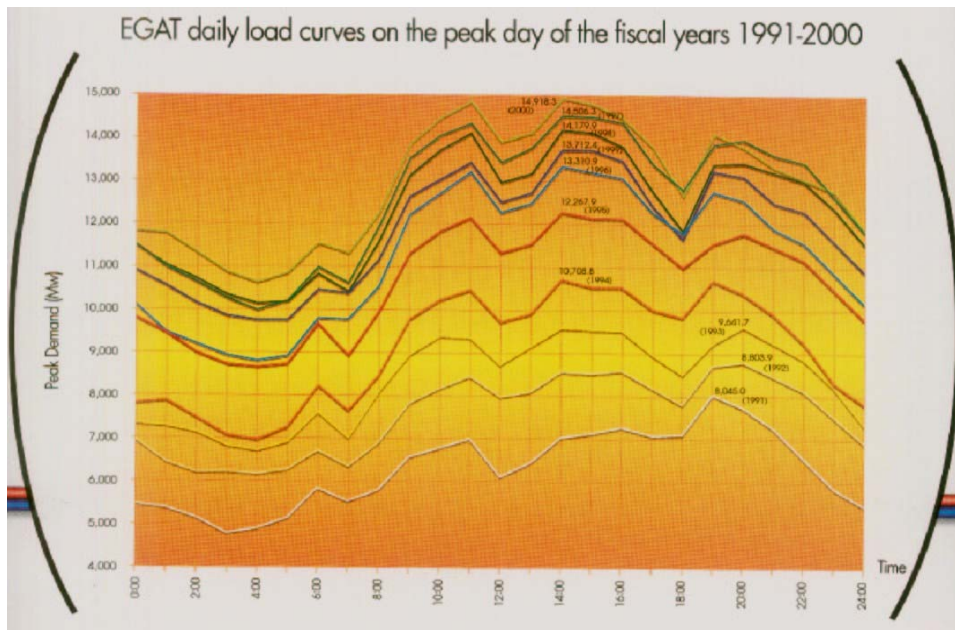
According to projection of peak power demand in Thailand, demand is expected to reach 30,587 MW by the year 2011 (see graphic I). The continual increase in power demand results not only in greenhouse gas emission in the form of CO₂ but also increased power generation costs because of the increased use of price-sensitive imported fuels. Electricity bills are a large part of industrial production costs, so that the rise in production costs of many products will come as a blow to the country’s competitive ability in the global market. That is why the concept of energy efficiency and load management contributing to a reduction in consumer demand for electricity as well as lower production costs are employed as a solution. The official debut of demand side management was under the slogan “Together in Conservation”. Since its first appearance, EGAT has played a proactive role in promoting the efficient use of power (Orapim Sompongse, 2004, pp.1-7).

Figure I

From *Demand Side Management 1993-2000* by Electricity Generating Authority of Thailand, Demand side Management Office, 2006, Bangkok: EGAT internal document.

Although the recession in Thailand's economy during 1997 to 2000 caused declining demand for electricity, the campaign for energy efficiency remains important due to the price increase of imported fuels, a result of Thai currency depreciation. Consequently, the energy efficiency campaign must be continuously promoted to reduce demand even when Thailand's economy recovers. This will enable sustainable economic development in the future.

The rising demand for electricity during peak hours (10.00am-11.00am, 01.00pm-04.00pm and 07.00pm-09.00pm, see graphic II) has led EGAT to increase generating capacity resulting in excessive power supply during off-peak hours. The "Together in Conservation" program is aimed to change and cut loads during peak periods to save energy and decrease peak demand. In the one word, this will also lead to reduced carbon dioxide emission.

Figure II

From *Demand Side Management 1993-2000* by Electricity Generating Authority of Thailand, Demand side Management Office, 2006, Bangkok: EGAT internal document.

According to the implementation target and performance achievement of Thailand's demand side management (see table I), the initial targets of the five-year (1993-1997) plan for demand side management was achieved with a nearly triple reduction of peak demand, energy demand and carbon dioxide emissions with lower operating costs after the program had been implemented for only one year. As of 30 June 2000, the program's goal was well achieved with the spending of only one-third of the allocated capital investment. The program also benefited all parties. First, consumers have enjoyed unchanged satisfaction and consumption, and lower power bills. Second, the country saved on investment in building new power plants (including transmission lines) of more than 30,120 million baht. Lastly, the environment was relieved of carbon dioxide emission of 2.69 million tons.

Table I

Implementation Target and Performance Achievement of Thailand DSM

Target	Initial Target (1993 - 1997)	Modified Target (1994 - 1998)	Performance Achievement As of June 30, 2000
Peak Demand Saving (MW)	238	700	755
Energy Demand Saving (GWh)	1,427	3,403	3,810
Carbon dioxide Emission Reduction			
(million tons)	1.16	2.5	2.69
Investment (million baht)	6,000	6,000	1,814

From *Demand Side Management 1993-2000* by Electricity Generating Authority of Thailand, Demand side Management Office, 2006, Bangkok: EGAT internal document.

The strategy which had been used, was that of market transformation by which EGAT encouraged importers and local manufacturers to import and produce cost-saving and high efficiency electrical appliances. Meanwhile, the strategy also cultivated energy conservation awareness and educated the public on energy efficiency and its benefits. Moreover, the “Attitude Creation Program” was launched to emphasize energy conservation awareness and efficient utilization that has long-term consequences for the generations to come. This program focused on encouraging Thai youth to pursue energy efficient technologies which could assure sustainability for energy conservation.

To sum up, up to the year 2007, the “Together in Conservation” has been a success with the cooperation and willing up of support from consumers, as well as private and government organizations. Its success has been proved an excellent example, both on a global scale and locally. In June 2007, the Demand Side Management (DSM) program achieved its success by reducing peak demand by 1,435.2 MW , energy demand by 8,148.3 GWh., and CO₂ emissions by 5.63 million tons. The program is successful because it could create energy efficiency awareness among Thai people (Electricity Generating Authority of Thailand, 2007).

2.2.2 The Concept of “AAA”

EGAT has used the concept of “AAA” which includes “Energy Efficient Appliances”, “Energy Efficient Attitude”, and “Energy Efficient Architecture”. The “Labeling Program” was introduced in the Energy Label No.5 that has been promoted as energy saving for various appliances and products such as fluorescent tubes, refrigerators, and brown rice. Moreover, EGAT launched the “Green Building” program that focused on energy efficiency in buildings in the residential, commercial, and industrial sectors. At the same time, the campaign enhanced energy conservation awareness among the young generation. For example, there was the “green learning room” program for schools.

1. The concept of energy efficient Appliances (A1) The focus is on promoting the use of high efficiency appliances. EGAT stimulates local manufacturers and importers to produce and import high efficiency appliances.

2. The concept of energy efficient Architecture (A2) The aim is to stimulate the commercial and industrial sectors which are a large portion of the country’s energy consumption to reduce energy use by educating the sectors about energy efficiency and introducing lighting improvements, efficient ballasts, efficient air-conditioning systems, load management, and thermal energy storage systems.

3. The concept of energy efficient Attitude (A3) The emphasis is on creating energy conservation awareness and habits among younger people. This program has been set up at schools throughout the nation to allow students to learn the importance of energy conservation through the efficient use of electricity. At the same time advertising and public relations helped promote energy saving habits among the public.

2.2.3 Operating Performance

The operating performance of Thai demand side management will be divided into six programs as follows:

- Residential Sector
- Commercial Sector
- Industrial Sector
- Labeling Program
- Attitude Creation Program and
- Other Programs

1. Residential Sector

The residential sector's electricity consumption accounts for 25 percent of the nation's energy consumption and 30 percent of peak load. Therefore, reducing electricity consumption in this sector can significantly lead to overall energy efficiency. In order to persuade consumers to lower energy use in the household, the use of energy efficiency equipment was introduced. The implementation of this program has emphasized several selective appliances: refrigerators, air-conditioners, and electric lamps under the theme "Together in Conservation". The programs for energy efficiency equipment are as following:

- **Energy Efficient Fluorescent Program:** This program persuades consumers to use high efficiency tubes (thin tubes) instead of low efficiency fat tubes. The program has succeeded because five fluorescent manufacturers agreed to replace the production of 20W and 40W fluorescent tubes (fat tubes) with 18W and 36W (thin tubes) that use 10 percent less energy, but offer an equivalent amount of light. This program persuades consumers to use high efficiency tubes (thin tubes) instead of low efficiency fat tubes. It has been an enormous success because it wipes fat tubes out off the market.
- **Compact Fluorescent Lamp Program:** Its aim was to persuade consumers to use 7W, 11W, and 18W compact fluorescent lamps instead of 25W, 40W, and 60W incandescent lamps.
- **Energy Efficient Refrigerator Program:** The program began by persuading manufacturers and importers to test their products for energy efficiency by labeling efficiency ranked into five different levels.

- Energy Efficient Air-conditioner Program: After the success of labeling refrigerators, the energy efficient air-conditioner program was introduced.

- Energy Efficient Ballast Program: The program was initiated on February 1, 1998. The high efficiency ballasts called “Safety Ballast No.5” which consume less than 6W, resulting in 40 percent energy saving, were introduced.

More recently, the “Nutritious Brown Rice program” was promoted to reduce electricity consumption as its milling process demands less electricity than refined rice. It can save up to 60 percent of energy used in the milling process. Furthermore, it is not only rich in nutritional value that contributes to good health for Thai people, but also creates more income for farmers.

2. Commercial Sector

The commercial sector consists of office buildings, hospitals, hotels, schools, and shopping complexes. This sector accounts for 35 percent of the nation’s energy consumption and 35 percent of the peak load. As the sector was seen to offer enhanced energy-saving opportunities, EGAT launched the “Green Building” program on September 20, 1995. The “Green Building” program targeted: Existing Buildings, New Buildings, and the Energy Conservation Consultant program.

3. Industrial Sector

The industrial sector accounts for 43 percent of the nation’s energy consumption and 35 percent of peak load. In addition, electricity bills are also a large portion of production costs as mentioned above. Thus, the program will impact the industry’s competitive position as well as the country’s competitive edge. A number of different programs have been implemented in each factory. The programs under implementation are as follows:

- Energy Monitoring and Demand Control System
- Lighting and Electrical Appliance Retrofit Program
- Controlled Factory Consultant Program
- High Efficiency Motor Program
- Energy Service Company Pilot Project

- SMEs Cost Reduction and Energy Efficient Technologies Program

4. Labeling Program

As mentioned before, local manufacturers and importers of refrigerators and air-conditioners were encouraged to test and label their products for energy efficiency. Thailand's labeling has been successfully attained by voluntary cooperation from both private and government sectors, under the campaign of producing and utilizing high efficiency appliances. Later, the efforts will move to focus on new types of energy efficient appliances.

5. Attitude Creation Program

In order to ensure sustainable energy conservation, EGAT has launched the Attitude Creation program to create awareness of energy conservation and efficient utilization which could impact on long-term consequences. It is important to create a positive attitude towards energy efficiency in consumers, because it will hopefully cultivate conservation habits in other aspects as well. Especially for Thai youth, EGAT in cooperation with the Ministry of Education and Bangkok Metropolitan Administration's office of education initiated the "Green Learning Room" program to build awareness of sustainable energy conservation among school children from kindergarten to high school level. That is because children's behavior can be easily adjusted and energy conservation habits will be an integral part of their life in the future.

6. Other Programs

Beside the above efforts, there are other programs that Thailand's demand side management has commenced in order to reduce electricity demand. These are the following:

- Lighting Retrofit Program in Royal Project Foundation
- Street Lights Program
- Appliance Testing Laboratory Program

2.3 THE CONCEPT OF GENERAL ELECTRICITY ENERGY SAVING

2.3.1 The important things that we should consider before choosing electrical equipment

The important things that we should consider before choosing electrical equipment are as follows.

1. Electricity energy loss. We should choose No. 5 label electrical equipment that has the number of Watts appropriate to our use.

2. Safety. We should choose electrical equipment whose quality is guaranteed by the Thai Industrial Standards Institute.

3. Use. We should choose electrical equipment that is easy to use and install.

4. Maintenance. We should choose electrical equipment that is easy to maintain and to find spare parts for.

5. Price. We should choose electrical equipment that has a reasonable price (Fai-fa-huang-yai, 2007, pp.8).

2.3.2 Unit of Electricity

Electricity unit is the amount of electricity energy used by electrical equipment during a period of time. It is called a “unit” or “kilowatt hour”. Within the same period of time, equipment that has a higher rating in Watts will consume more electricity than equipment that has a lower rating.

$$1 \text{ Kilowatt} = 1,000 \text{ Watts}$$

$$1 \text{ Kilowatt per hour} = 1 \text{ Unit}$$

$$\text{Number of unit} = \frac{\text{number of Watts} \times \text{number of hours}}{1,000 \text{ Watts}}$$

$$\text{Electricity payment} = \frac{\text{number of Watts} \times \text{number of hours} \times \text{electrical rate/unit}}{1,000 \text{ Watts}}$$

(Fai-fa-huang-yai, 2007, pp.59)

2.3.3 Electrical Equipment

1. Refrigerator

How to choose refrigerator

- The refrigerator should have the No. 5 label.
- The size of refrigerator should be appropriate to the size of family.
- A two-door refrigerator consumes more electricity energy than a one- door refrigerator.
- The refrigerator should have a thick insulating wall.

How to use and maintain refrigerator

- Do not open the refrigerator too often or put hot food in it because heat from the food causes the compressor to the cool refrigerator again by releasing heat via a filter at the back of refrigerator.
- Always clean the filter at the back of refrigerator because dust in the filter could increase the compressor's work load.
- Always check the refrigerator after it has been used for a period of time (Fai-fa-huang-yai, 2007, pp.27-29).

2. Air condition

The highest electrical consumer in a house is an air-conditioner.

How to choose air-conditioners

- Before choosing an air-conditioner, consider the relationship between room sizes and air conditioner sizes.

How to use and maintain air-conditioners

- Air conditioners should be set at 25-26 degrees to save energy. Decreasing 1 degree could increase 10% electricity bills by 10%.
- Clean the filter of the air conditioner every month (or more if necessary).
- Check and clean air conditioners twice a year (Fai-fa-huang-yai, 2007, pp.31-33).

3. Television

How to use and maintain Television

- It is necessary to unplug the television every time we do not use it to save electricity (Fai-fa-huang-yai, 2007, p.38).

2.4 RELATED STUDIES

Rattana Tungarmorn (1986:abstract) studied the awareness of energy saving of junior high school students in Bangkok by distributing 410 questionnaires to students studying in 1984. It was found that students have good awareness of energy saving. They understood and received an average score of 13 out of 20 for in tests of their knowledge of energy saving and responsibility for energy saving (the average score was 34 out of 40). They are interested in and participated in energy saving activities (21 out of 40 scores in average). Female students were found to have higher awareness of energy saving than male students. The differences in students' residences, parents' educational levels and parents' income do not affect their awareness of energy saving significantly.

Junlada Chaihoudcharoen (1993: abstract) studied the factors that affect the electricity saving behavior of 408 housewives in Bangkok. It was found that the housewives moderately saved electricity. The influential factor was their family members. The difference in family members causes the difference in electricity saving behavior. The differences in other factors: the perception of information, the attitude toward electricity saving, the knowledge of electricity saving caused the differences in electricity saving behavior. The researcher found out that the respondents that have at least 6 members in families, that acknowledge the information, that have a good attitude toward electricity saving, and that have good knowledge of electricity saving known how to save electricity better than other respondents. The researcher suggested that we should provide electricity saving information to housewives via television and radio programs as they are easier to reach by these media. Moreover, we should arrange exhibitions and send brochures to provide information about general knowledge of electricity energy saving, the government policy, the way to choose, use, and maintain electrical equipment and we should create a good attitude toward electricity energy saving. All these suggestions should be continuously pursued by the government and the private sector.

Sasivimon Parnsri (1995: abstract) studied information perception, knowledge, attitudes, and electricity energy saving behavior of government, state enterprise, and private organization staff in Bangkok. The finding was respondents receive most of their electricity energy saving information through television. Other media are radio, newspapers, posters, and brochures. Information perception and attitudes toward electricity energy saving are positively related to electricity energy saving behavior. Knowledge of electricity saving, gender, age, education level and income have no relation with electricity energy saving behavior.

Arunya Raksitanon (1995: abstract) studied the electricity energy saving behavior of 280 people living in Muang District, Nontaburi province. The findings were as follows.

1. Respondents that moderately saved electricity energy were between 26-35 years old, had a bachelor's degree or Master's degree, were government officials whose family average income was 30,000 baht per month, paid electrical bills of more than 400 baht per month, had 1-4 family members, and had more than 7 pieces of electrical equipment per family.

Respondents that saved electricity energy least were younger than 25 years old, finished study at primary school level, were private company officials or did general work whose family average income was 20,001-30,000 baht per month, paid electrical bills of less than 400 baht per month, had more than 4 family members, and had less than 7 pieces of electrical equipment per family.

2. The respondents receive electricity energy saving information from television, newspaper, and radio. More than half of the respondents receive electricity energy saving information every day.

3. The respondents have moderate level of knowledge of electricity energy saving and moderately save electricity energy.

4. From the Chi-Square test, the electricity energy saving behavior was significantly related to age and income. The electricity energy saving behavior has no relationship with education level, occupation, electrical expenditure, membership family, information perception, and knowledge of electricity energy saving.

Waritsara Sarakosas (1996: abstract) studied the advertising of the Electricity Generating Authority of Thailand (EGAT) on electricity energy saving to stimulate the interest of people in Bangkok. The main finding was that satisfaction with advertising content was related to interest, understanding, and behavior. The

advertising content could stimulate people to be interested in electricity energy saving. Satisfaction with actors or actresses and slogans has a relationship with interest in electricity energy saving. There is no difference in the interest of male and female respondents but there is a difference in electricity energy saving behavior. Females display more electricity energy saving behavior than males.

Chantararat Seangtong (1996: abstract) studied the opinions on electricity energy saving of 260 private company officers. The finding is as the followings.

1. Most respondents are men, aged less than 25 years old, single whose education level is lower than bachelor's degree, do operating task, have income less than 20,000 baht per month, live in a townhouse, and have received electricity energy saving information.

2. Almost all of the respondents have positive attitudes towards electricity energy saving. The factors that affect their opinions are income, education level, dwelling, and the influence of media such as television, radio, newspaper and people such as colleagues, relatives, and neighbors.

From the findings above, we should encourage an electricity saving environment for children and government offices should provide the good examples. There should be advertising via various media and done continuously.