CHAPTER 1

INTRODUCTION

Energy efficiency standards and labels for household appliances are now becoming a common practice in many countries in the world. Harrington and Damnics (2002) stated that for developing Asian countries, these options can hedge against increases in energy intensity, particularly that of electricity, towards their pursuit of economic development.

Energy efficiency standards are the specified minimum energy efficiency levels that products must meet before they can be legally sold. According to Turiel *et al.* (1997), there is no single methodology for establishing standards as the best approach may differ with goals, appliance type and local conditions. However the author stated that most approaches begin with data collection phase, followed by an analysis phase and then standard setting phase.

Meanwhile, Mahlia *et al.* (2002) defined energy label as a mandatory or voluntary sticker that is affixed to products or their packaging containing information on the energy efficiency or energy consumption of the product. Usually, labels enable consumers to compare energy efficiency of appliances and also encourage manufacturers to improve energy performance of appliances

During the United Nations Regional Symposium on Energy Efficiency Standards and Labelling held in Bangkok, Thailand, 29 - 31 May 2001, participants

that included government planners, equipment manufacturers, consumer union representatives, and technical experts have identified various important lessons learned in Asia on energy labelling and energy efficiency standard. These importance are enumerated below (Harrington and Damnics, 2002):

- Energy standards and labeling programs are the most cost effective way for countries to realize their energy efficiency goals
- Standards and labeling programs have proven to be an effective climate change mitigation measure in all countries in which they are instituted
- It is the right of every country to determine the appliances and equipment that are included in its national standards program and the stringency of the standard applied
- Harmonizing or aligning standards, labels and test procedures across countries results in expanded export markets for manufacturers, as well as improved choices and lower energy bills for consumers

1.1 Background of TV energy consumption

In the United States, Rosen and Meier (2000) reported that residential television sets (hereinafter referred to as "TV sets or TVs") consumed 31 TWh of electricity in 1998, with an average of 150 kWh per household. Their analysis also showed that approximately 23% of TV energy use is consumed while the device were not active.

Siderius (1999) reported that the average penetration of TVs into EU households in 1995 was 135%, but the total stock grew at 4.3% per annum from 1991 to 1997, resulting in a forecast penetration rate of approximately 177% by 2010 and a stock of 288 million units. This means that if the existing technology were maintained, TV on-mode consumption in the EU would be expected to increase from approximately 25.5 TWh/year in 1995 to approximately 45.8 TWh/year in 2010 (Siderius, 1999). However, the author stated that if best available technology were used, the energy consumption in 2010 could be limited to only 29.0TWh/year with a saving of 37%.

Meanwhile Lin (2002) reported that China is one of the largest consumers and producers of consumer electronics whereby over 40 million color TVs were produced in 2000. The author also stated that many people unplug their TVs and other audio/visual equipment in the past as a safety precaution. However this practice is loosing popularity today due to the convenience of turning off the equipment with a remote control. As such, standby power loss from this equipment is approximately 10% of urban household electricity use.

In Australia, Harrington and Kleverlaan (2001) discovered that there is an encouraging decrease in TV standby power (remote control off) since 1991, with an average standby falling from 16 Watts in 1991, to just over 5 Watts in 2001. Their study also showed that fifty percent of Australian TVs were found in off mode when not in use while the other 50% were in standby mode.

In Malaysia on the other hand, the popularization of 24 hours pay-TV, interactive video games, web-TV, VCD and DVD are poised to have a large impact

on overall TV energy consumption. Additionally the numbers of TV ownership have also increased tremendously over the past three decades. With the increase of overall TV energy consumption, energy efficiency standard and label is one of the highly effective policies for decreasing electricity consumption in the residential sector. Energy efficiency standard and label for TVs in Malaysia is also capable of reducing consumer's electricity bill and contributes towards positive environmental impacts.

In the past, Mahlia (2002) and Saidur (2001) have studied the importance of energy efficiency standard and label of household room-air conditioners and refrigerator-freezers each respectively. Additionally, energy standard for lighting has been established in Malaysia and label program for electric fan would be completed in the near future. Therefore this study attempts to complete the whole picture. Moreover, TV set is an appliance that needs to be given an extra attention due to its penetration in most households and the observed increase in its power consumption.

The methods adopted in this study are statistical analysis to set the standard and engineering/economic analysis to examine the potential efficiency improvement and cost estimates. The statistical analysis is conducted after separating TV sets according to its classes, which are conventional CRT TV, LCD TV, Projection TV and Plasma TV. The method to calculate the energy, economic and environmental impact is carried out by considering both TV's active and standby electricity consumption. In addition, the saturation factor is integrated in the calculation to validate households with more than a single TV set ownership. Meanwhile, the energy label adopted in this study is the comparative style which ranks TV sets according to number of stars and displays the energy efficiency index for each unit.

1.2 Objectives of study

This study focuses on cost-efficiency analysis in support of the energy efficiency standard and label for TV sets in Malaysia. Its main objectives are:

- To propose an energy test procedure for TV sets which serves as the protocol to consistently evaluate energy use and the basis for implementing energy efficiency standard and label. The test procedure is expected to include guidelines to measure both TV active and standby electricity consumption.
- To propose a suitable standard and label program for TV sets in Malaysia which serves as a target limit on energy performance and provide consumers with the data necessary for making informed purchases. It is expected that a realistic standard program that could be achieved by manufactures and a label that is consistent throughout product type as well as informative are proposed
- To conduct a cost-efficiency analysis to examine the potential TV efficiency improvement and cost estimates on the future energy consumption. It is expected that the efficiency of TV set could be improved greater than the proposed standard with a payback period before its average lifespan.
- To justify the implementation of energy efficiency standard and label for TV sets in Malaysia could contribute towards a significant amount of energy savings, economical benefits and positive environmental impact at national level. It is expected that a significant amount of energy savings, economical benefits and positive environmental impact could be achieved.

1.3 Limitations of study

The area that is considered in this study is significant for the future energy demand in this country. However, there are certain limitations in this study. Firstly, as we know a TV is a medium of entertainment as well as information. As such, apart from the residential sector, TV sets are also utilized in the commercial and industrial sector as well as government organizations. However, this study only examines the benefits of energy efficiency standard and label in the residential sector at the national average level.

Besides that, the developed energy efficiency standard and label is based on the household and market survey data. This method is also utilized by Rosen and Meier (2000) in the United States. In this study, the TV usage pattern is derived from household survey. However the survey is limited to only 3 units of TV per household. This is due to the fact that in an average Malaysian bungalow house, (the type of residence which records the highest number of TVs per household) the maximum number of TV ownership is expected to be 3 units per household (Centre for Education and Training in Renewable Energy Efficiency Malaysia - CENTREE, 2002). Therefore an investigation regarding TV usage pattern on 3 TVs per household seems satisfactory.

There are many methods applied in this study in order to derive the energy efficiency standard and label for TVs in Malaysia. To estimate the number of TV ownership, a suitable method will be selected. The baseline data however, have been collected from the General Report of Population Census of Malaysia (1970, 1991 &

2000). The survey is done every 10 years and to date only the data for the year 1970, 1980, 1991 and 2000 are available. Hence, it can be seen that the TV ownership data were estimated by extrapolating only four available points. However this seems to be the best solution taking into consideration that Malaysia like any other developing country is lack of these data.

1.4 Organization of the thesis

The dissertation is divided into 5 chapters that have been developed consecutively. The remaining chapters of this dissertation are organized as follows:

Chapter 2 presents a literature review of previous studies that provides the theoretical and academic background for this study. A comprehensive review is done to examine its relations and convenience with this study. The related areas reviewed include journal articles, conference papers and research reports.

Chapter 3 discusses research methodology that consists of test procedure development, approaches in setting TV standard and label, data collection method, data analysis method and method to conduct cost-efficiency analysis. Besides that, the method to calculate the energy, economic and environmental impact are also examined.

Chapter 4 presents an analysis of the collected and survey data. It starts with the tabulation of the collected and survey data and progresses into the analysis of these data. The analysis include engineering/economic analysis, calculation of the energy, economic and environmental impact as well as cost-efficiency analysis.

Chapter 5 analyses the implication of this study's findings and makes recommendations from the evaluation of TV energy standard and label.