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Research paper

Residential Energy Efficiency: Benefits of Minimum Energy Performance Standard (MEPS) Implementation for Television in Malaysia

Aishah Mohd Isa[1]*, Mohd Eqwan Mohd Roslan[2], Siti Fatihah Salleh[3]

[1]*Department of Electrical Power Engineering, College of Engineering, Universiti Tenaga Nasional*
[2]*Department of Mechanical Engineering, College of Engineering, Universiti Tenaga Nasional*
[3]*Institute of Energy Policy and Research, Universiti Tenaga Nasional*
**Corresponding author E-mail: aishah@uniten.edu.my*

Abstract

A popular strategy for promoting energy efficiency at the national level is through the minimum energy performance standards (MEPS). Malaysia implemented MEPS in 2013 for five common household appliances; air conditioners, refrigerators, fans, televisions, and lamps. These products must undergo a performance test. Only products that meet the minimum standards are allowed to enter the Malaysian market. Based on their performance, ratings are awarded ranging from 2-star up to 5-star. A survey the authors conducted in 2017 found that about 98% of televisions sold in Malaysia have already achieved 5-star rating. This paper explores the implications of this finding and quantifies the possible savings that can be achieved in terms of electricity savings and emission reductions.

Keywords: *energy efficiency; emissions reduction; minimum energy performance standards (MEPS); television; standards and labelling (S&L);*

1. Introduction

Television is a common household appliance in Malaysia, in fact, over 98% of households in Malaysia are reported to own a television set by 2016 [1]. A marketing survey estimated that by 2011, Malaysians spend on average 3.9 hours daily on television [2]. According to another survey conducted for an urban state in Johor, the average television viewing time may be much higher, reaching up to 8 hours daily [3]. Televsion sets can be used not only for watching cable and satellite program broadcasts, but also for playing electronic games, watching DVDs and videos, and listening to the radio. When not in use, televisions are typically placed on standby mode rather than switched off, therefore televisions still consume electricity.

Given the high prevelance and utilization of televisions in Malaysian household, televisions were selected as one of the appliances that must adhere to the Minimum Energy Performance Standards (MEPS) since 2013. After three years of MEPS implementation, a survey was conducted to ascertain the impacts of MEPS implementation in Malaysia. This paper analyzes the results from the survey and focuses on the impacts of MEPS specifically for televisions.

2. MEPS Implementation in Malaysia

The MEPS regulation is designed to remove the worst performing products by prescribing a minimum efficiency (or maximum energy consumption) manufacturers must achieve [4]. Malaysia officially implemented MEPS with the Electricity (Amendment) Regulations 2013 which was gazetted on 3rd May 2014. Under this regulation, Standard and Industrial Research Institute of Malaysia (SIRIM) Berhad, in collaboration with the Energy Commission, was tasked with developing mandatory standards for household appliances. As of July 2018, this regulation has established the standards and requirements for five electrical appliances: refrigerators, air conditioners, televisions, domestic fans and lamps.

With the standards in place, each product model must undergo stringent tests to ensure compliance with both the safety and performance requirements. Testing may be done either locally at SIRIM or abroad at test laboratories recognized by the Department of Standards Malaysia. Products that satisfy both requirements are issued a Certificate of Approval (COA) by the Energy Commission to certify that the product is safe for use in Malaysia.

Laboratory test reports also include the energy efficiency factor (EEF), which is used to determine the product model star rating. The Energy Commission uses a 1-star to 5-star ranking system to indicate the energy performance of the appliance, where a 5-star rating is awarded to products that achieve the most energy efficient category based on its energy efficiency factor. Products that fail to achieve at least 2-star rating are prohibited from being sold in the Malaysian market.

The star rating allows consumers to compare the levels of energy efficiency and to estimate the running costs of appliances before purchase. Except for lamps, it is mandatory for all MEPS-compliant appliances to be affixed with an energy rating label that indicates its tested efficiency. An example of the energy rating label for MEPS-compliant appliances is shown in Figure 1.

2.1. MEPS Implementation for Television

The *MS 2576:2014 Minimum Energy Performance Standards (MEPS) for Television* is specifically introduced by SIRIM for televisions that can be connected to main power supply and for

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consumer use, with screen sizes up to 70 inches on the diagonal (equivalent to 177.8 cm). Television sets powered solely from batteries; and front or rear projection display devices are excluded from the standards The types of televisions included under MS 2576:2014 are plasma, liquid crystal display (LCD), light emitting diode (LED), and cathode ray tube (CRT). Star rating for television is awarded based on the star index value, as shown in Table 1.



Fig. 1: Energy Rating Label for MEPS-compliant Appliances

Table 1: Star rating index

Star rating	Star index value
5	+20 % ≤ Star index
4	+10 % ≤ Star index < +20 %
3	-10 % ≤ Star index < +10 %
2	-20 % ≤ Star index < -10 %
1	-30 % ≤ Star index < -20 %

Star index differs according to screen-size and is determined by SIRIM based on a combination of measured test values as well as local market surveys [5].

3. Methodology

To analyze the impact of MEPS on electricity savings, comprehensive sales data of MEPS electrical appliances covering the years 2013-2015 were acquired from local MEPS-compliant appliance manufacturers and distributors. Collected data were aggregated according to appliance category and star rating. The data mainly include information on the annual sales volume by model and technical details of the sold equipment's energy performance based on SIRIM test results.

Based on the data collected, the electricity consumption of MEPS-compliant appliances and marketshare by star-rating were determined. From the appliances consumption analysis, it was possible to derive the electricity savings, cost savings and emissions reductions as compared to the consumption of 2-star appliances of the same equipment type and capacity.

To calculate total annual electricity consumption, the annual electricity consumption of a product was multiplied by the number of products sold in that year.

$$AEC_{total,year} = \sum \left(AEC_{model} \times NUS_{model,year} \right) \quad (1)$$

Where $AEC_{total,year}$ [kWh] is the total electricity consumed by MEPS-compliant appliances in a particular year while AEC_{model} [kWh] is the annual electricity consumption for each model $NUS_{model,year}$ is the number of units sold for a model in that same year.

The market share of MEPS-compliant appliances was calculated based on their star rating and the appliance category as shown by following equation:

$$MS_{at,sr} = \frac{NUS_{at,sr,year}}{\sum_{at} NUS_{at,year}} \times 100 \quad (2)$$

Where $MS_{at,sr}$ [%] is the market share by appliance type of a particular star rating, $NUS_{at,sr,year}$ is the number of units sold for that particular appliance type and star rating in a year, and $NUS_{at,year}$ is the total number of units sold for that particular appliance type and year.

To estimate the maximum potential savings that can be achieved, the electricity savings were compared to the savings from the lowest 2-star rating model. This estimation is consistent with the methodology applied by Energy Commission in the National Energy Efficiency Action Plan (NEEAP) [6]. Thus, the annual electricity saving, *AES* (kWh) gained from the use of each MEPS-compliant appliance can be estimated by comparing its calculated annual electricity consumption with the annual consumption of the lowest 2-star rating model of the same equipment type as shown below:

$$AES_{model} = AEC_{model} - AEC_{lowest\ 2-star\ rated\ model} \quad (3)$$

Then, the total annual electricity saving, AES_{total} (kWh), of MEPS-compliant appliances was calculated by aggregating the products of electricity saving for each model and the number of units sold in a particular year from that same model.

The annual electricity savings calculated can then be used to determine the cost savings by multiplying the calculated value with the electricity tariff.

$$CS_{total,year} = AES_{total,year} \times ET_{domestic} \quad (4)$$

Where $CS_{total,year}$[MYR] is the total cost savings in a year while $ET_{domestic}$ [MYR/kWh] is the average electricity tariff for residential sector. The residential sector tariff was used since MEPS in Malaysia is specifically targeted for the residential sector. The actual value for $ET_{domestic}$ was extracted from an Energy Commission report whereby it was found that the average domestic tariff is MYR 0.3166/kWh [7].

Similar to total cost savings, annual carbon emission reduction, $CER_{total,year}$ [ktCO$_2$eq] was also determined based on the total annual electricity saving, $AES_{total,year}$ [kWh]. This time, the grid emission factor, GEF_{region} [tCO2eq/MWh] is utilized.

$$CER_{total,year} = AES_{total,year} \times GEF_{region,year} \times GA \quad (5)$$

where *GA* [%] is the grid allocation.

Malaysia is served by three electricity grids; the TNB grid for Peninsular Malaysia that serves about 90% of the electricity demand, the SEB grid for Sarawak and the SESB grid for Sabah. Sabah and Sarawak are states on the East Coast of Malaysia. Since each grid has different profiles for generation capacity, the grid emission factor is also different for each grid as tabulated listed in Table 2.

Table 2: Grid Emission Factor by Region

Grid emission factor [tCO2/MWh] **	2013	2014	2015
Peninsular Malaysia (TNB Grid)	0.742	0.694	0.659
Sabah (SESB Grid)	0.533	0.536	0.572
Sarawak (SEB Grid)	0.430	0.335	0.421

Source: Compiled from [8], [9] and [10]

The annual carbon emissions reductions are allocated amongst the three grids using the same ratio adopted in NEEAP, whereby 90%

of the carbon emissions reductions is allocated to Peninsular Malaysia, while Sabah and Sarawak are allocated 5% each.

4. Result Analysis

The researchers successfully obtained sales data for 1,150 COAs out of the 1, 215 COAs issued by 2015, which constitutes 95% coverage of the data set for all MEPS-compliant appliances.

Based on the data collection conducted, it was found that flat-panel televisions, such as LCD televisions, are the most commonly sold television type in Malaysian market. This is in line with global market trends where demand for flat panel display has also increased dramatically with decreased unit prices and unit power consumption [11].

In terms of the market size, the authors are not authorized to disclose the exact sales volume for each appliance type. However, it is possible to share that for televisions, the annual sales fluctuate at about one million units. Figure 2 shows the distribution of annual electricity consumption (taken from test reports) for all MEPS-compliant television models, grouped by screen size.

It would be easy to infer from Figure 2 that television models with bigger screen sizes will consume more electricity. However, a closer look would reveal that for some of the models, television models with a larger screen size may still consume the same amount or even less amount of electricity than television models with smaller screen sizes.

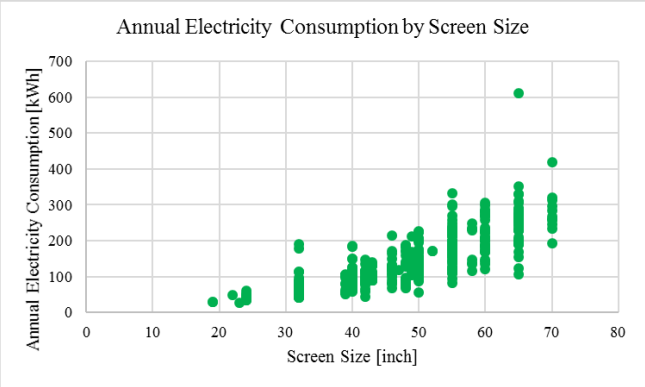


Fig. 2: Annual Electricity Consumption by Screen Size

The next figure shows the market share of television models by star-rating. The television market in Malaysia is dominated by 5-star rating models. It can be observed that the share of 5-star models is actually decreasing from 99.7% in 2013 to 98.6% in 2015. Data shows that new television models were introduced into the Malaysian market in 2015 with lower efficiency values than the current market average. This is a disturbing development and warrants further investigation. This result also strongly suggests that it is time for a revision of the 5-star rating standards for televisions. This will ultimately provide a better range of efficient products for consumers.

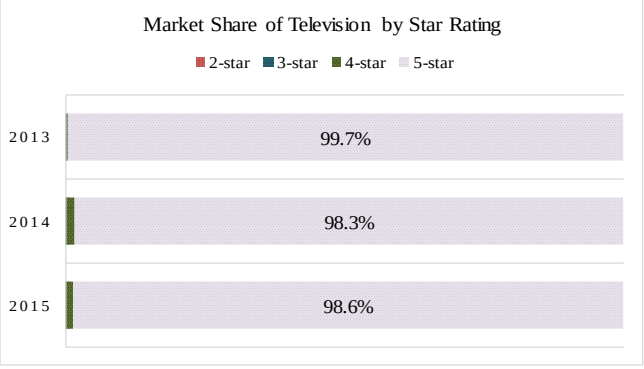


Fig. 3: Market Share of Television by Star Rating

Based on equations (1) through (5), it is possible to calculate the annual electricity consumption for MEPS-compliant televisions sold in 2013, 2014 and 2015 and hence derive the associated annual electricity savings, annual electricity cost savings and annual emissions reductions. The results are tabulated in Table 3.

Table 3: Annual Electricity Consumption, Annual Electricity Savings and Annual Emissions Reductions for Televisions Sold in 2013, 2014 and 2015

Parameter	2013	2014	2015
Annual Electricity Consumption [GWh]	106	122	99
Annual Electricity Savings [GWh]	139	190	165
Annual Electricity Cost Savings [RM '000]	43,905	60,021	52,201
Annual Emissions Reductions [million tCO_2]	99.29	126.67	105.98

It should be emphasised here that just because a television is purchased in one year does not mean that the electricity consumption will only be for that year. Instead, the consumption and thus all associated savings will carry over annually throughout the lifetime of the television. Based on this understanding, the total cumulative amount of electricity saving due to MEPS implementation for televisions in 2015 is 494 GWh while the cumulative electricity cost savings is RM 156,128 and cumulative emissions reductions is 331.93 million metric tonnes of carbon dioxide equivalent.

5. Conclusion

This paper concludes that the 2013 MEPS regulations has achieved its objective to mitigate increasing electricity consumption in Malaysia through the adoption of more efficient appliances. Reductions in electricity consumption were achieved in two ways. First, by mandating a minimum permissible energy performance standards, which resulted in the removal of inefficient appliances (that consume higher amounts of electricity) from the market. Second, by enforcing a comparative labelling and rating system which incentivized appliance retailers to offer products with higher energy efficiency ratings to consumers. At the same time consumers are able to take into consideration the energy consumption information on the comparative labels in their purchasing decisions.

Based on the survey conducted by the authors with support from the Energy Commission, the television market in Malaysia is already dominated by 5-star rating models. There may be several conflicting reasons for this dominance. For instance, this may indicate that MEPS requirements are too low which has caused many models to be awarded with 5-star rating. Another possible reason could be due to the lack of awareness among the consumers and retailers which affects the way they perceive MEPS label as an endorsement rather than a comparative tool. This could cause the lower star rated products to be seen as low-grade and selectively removed from the market. Regardless of the reason, the dominance of 5-star products in the market is not healthy and takes away consumer ability to choose between improved efficiency and cost.

Having a wide range of products with various star ratings does not mean that low efficiency products are welcomed as MEPS ratings should always be updated to reflect current global technology. Periodic reviews and updates of MEPS requirements are important to ensure that the current standards are at par with international standards. Otherwise, Malaysia may become a dumping ground for inferior or obsolete products, particularly if neighbouring countries have set higher star-rating criteria.

It is also equally important to educate consumers on smart energy purchasing habits when it comes to televisions. For instance, the results from this paper indicates that a smaller screen size may not necessarily mean less energy consumption, particularly in the 30 to 50 inches range. In terms of type of televisions, LED televisions

are the most efficient technology, while plasma screens can consume up to three times as much energy as an LED television of the same screen size. There are also some behavioural approach strategies to further save energy once the television is at home, including switching off the television set instead of putting it on standby, changing from default factory settings to reduce screen brightness, adjusting quick start options and using screen blanking features when listening to digital radio channels [12].

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