

SWITCH IT RIGHT

Incandescent (GLS) Phase-Out: Is Malaysia Doing It Right?



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CONTENT

Part	Item	Page
(i)	Acronyms	2
(ii)	Acknowledgement	2
1	Lighting Technology and Development	3
2	Challenges in phasing-out GLS	8
3	CFL Market Sampling Study	11
4	Recommendation	18
5	Guideline to Users	22
6	The Way Forward	27
7	Reference	28

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Part (i) Acronyms

AG	Attorney General
AWER	Association of Water and Energy Research Malaysia
CFL	Compact Fluorescent Lamp
DOE	Department of Environment, Malaysia
EQA	Environment Quality Act 1974
EU	European Union
GLS	General Service Lamp (Incandescent light bulb)
IEA	International Energy Agency
JPSPN	National Solid Waste Management Department, Malaysia
KeTTHA	Ministry of Energy, Green Technology and Water, Malaysia
LED	Light Emitting Diode
ST	Energy Commission, Malaysia
US EPA	United States Environment Protection Agency



Part (ii) Acknowledgement

We would like to acknowledge the support given by the following organisations in successful completion of this report:

- (i) **Directorate-General for Energy, European Commission** – Input on EU's energy efficiency labelling, standard and implementation.
- (ii) **United States Environment Protection Agency (US EPA)** – has given written permission to AWER to reproduce the CFL light bulb cleanup and disposal procedures.
- (iii) **Energy Commission, Malaysia** – Input on the ongoing strategies for phase-out of GSL.

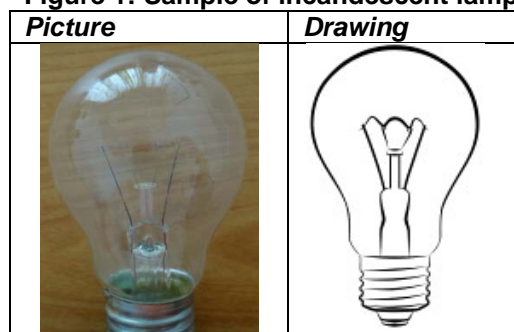


PART 1: LIGHTING TECHNOLOGY AND DEVELOPMENT

1.1 INTRODUCTION TO LIGHTING TECHNOLOGY

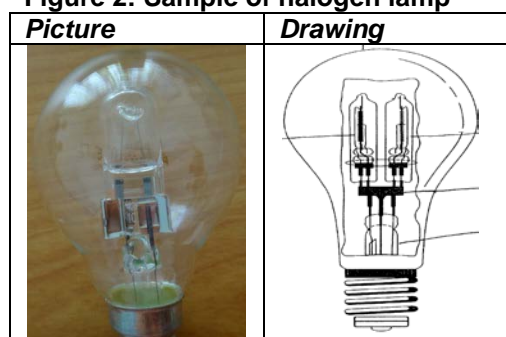
The incandescent light bulbs (or General Service Lamps – GLS) as shown in Figure 1, has been used as the light source since its simultaneous invention by Joseph Swan in the United Kingdom and Thomas Edison in the United States in 1879 [1]. The invention has improved quality of life around the world. The GLS emits light by heating metal filament to a high temperature that makes it to glow. This explains the heat emission from the GLS.

Figure 1: Sample of incandescent lamp (GLS)



The halogen lamp as shown in Figure 2 has a similar process compared to GLS. But, this process is enhanced with the metal recovery (via a chemical process) to extend the life of the bulb. It has slightly lower energy consumption compared to GLS.

Figure 2: Sample of halogen lamp



Fluorescent lamps as shown in Figure 3 use electricity to 'excite' mercury vapour that in return emits rays that will cause phosphorus to glow and produce light. This technology has been made smaller in the form of Compact Fluorescent Lamps (CFL) as shown in Figure 4, which is nominated to replace GLS. CFL is a technology developed during the 1973 oil crisis. CFL comes in two main forms that are the 'U' Tube type and the spiral type.

Figure 3: Sample of fluorescent light


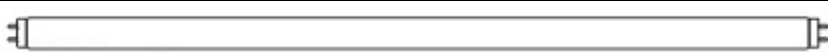

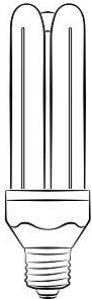




Picture	Drawing
	

Figure 4: Sample of CFL bulb

Picture ('U' Tube type)	Drawing ('U' Tube type)
	
Picture (Spiral type)	Drawing (Spiral type)
	

The Light Emitting Diode (LED) lamp as shown in Figure 5 is a semiconductor technology. The LED was used as indicators in many electrical appliances and now has evolved into a possible choice of future lighting. Currently, multiple diodes are used together to achieve the brightness of GLS and CFL.

Figure 5: Sample of LED bulb

Picture	Drawing
	

The lighting technology has grown into a complex and demanding technology. The challenge to use less energy while maintaining service quality is always there. Over the past two years, the LED technology has grown rapidly and deemed as future lighting solution. In the transition period, many older technologies are being phased-out either by demand or by legislation.

1.2 WHY INCANDESCENT (GLS) NEEDS TO BE PHASED-OUT?

Due to the nature of its operation, GLS converts electrical energy into light and heat energy. The total energy used in generating light is far lesser compared to generating heat. This makes it very inefficient. Furthermore, in tropical climate such as Malaysia, this heat is deemed unnecessary. Heat from lighting is considered as energy loss rather than useful energy [2].

This situation has prompted manufacturers to increase light energy output compared to heat energy in lighting technology. In addition to that, electricity use is directly linked to carbon emission. The higher the electricity usage the higher carbon emission will be. This was a basic comparison that has justified the need to phase-out GLS.

Diagram 1: Simplified Life Cycle of Lighting Products by AWER

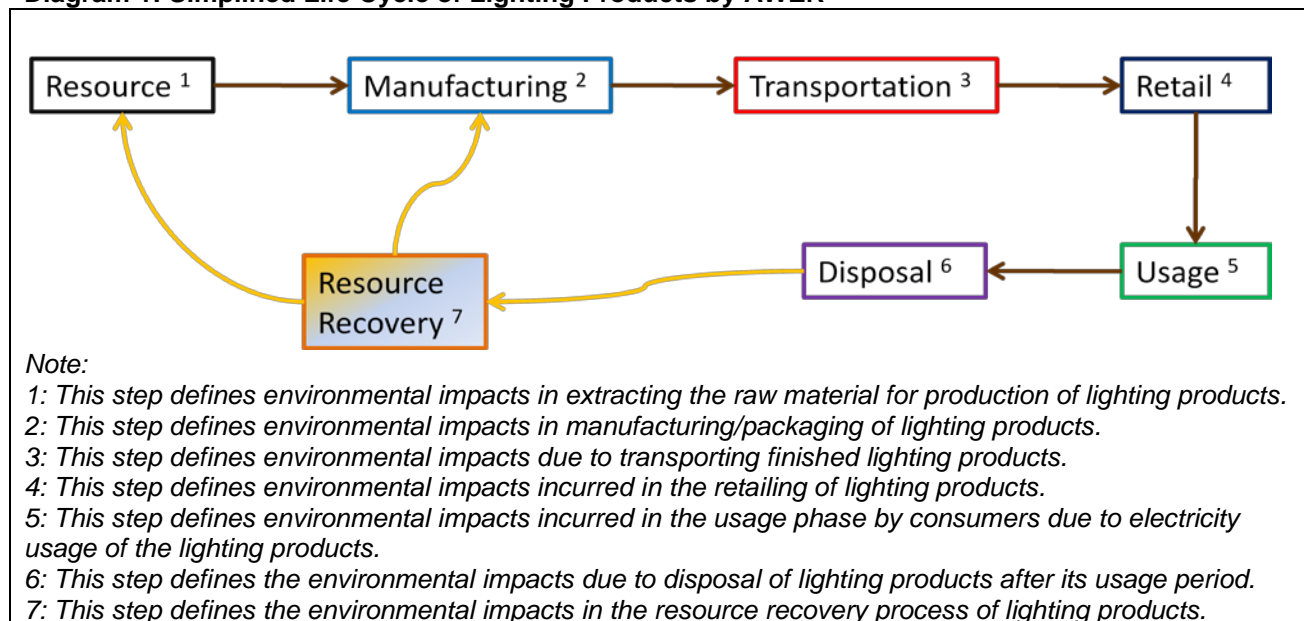


Diagram 1 shows a simplified life cycle of lighting products. Each step has its carbon footprint and in total, step 1 to 7 is known as “cradle to cradle”. If a product cycle stops at step 6, it is known as “cradle to grave”. These are important steps to ensure the total environmental impact can be measured. The Life Cycle Assessment (LCA) has identified that the carbon footprint in the lighting product lifecycle is highest during the consumption period (Diagram 1, Step 5) due to electricity usage. Average European power mix has a carbon footprint of 0.55 kg every kiloWatt-hour (kWh) [3]. In Malaysia, our carbon footprint for every kWh is 0.67 kg, which is almost 22% higher compared to EU.

Table 1: Summary of Life Cycle Assessment of Illuminants by Osram [3] is based on maximum 25,000 operating hours

Lamp type used	GLS Classic A	CFL Dulux Superstar Classic A	LED – Parathom A55
Power consumption (Watt / W)	40	8	8
Average operating hours per unit (h)	1,000	10,000	25,000
Number of light bulb(s)	25	2.5	1
Primary Energy Demand for manufacturing (kWh)	15.3	10.2	9.9
Primary Energy Demand for usage (kWh)	3290	658	658
Global Warming Potential for Manufacturing [kg CO ₂ -Eq./Lamp(s)]	3.5	2.2	2.4
Global Warming Potential for Usage [kg CO ₂ -Eq./Lamp(s)]	564	113	113
Acidification Potential for Manufacturing [kg SO ₂ -Eq./Lamp(s)]	0.010	0.012	0.017
Acidification Potential for Usage [kg SO ₂ -Eq./Lamp(s)]	3.5	0.7	0.7
Eutrophication Potential for manufacturing [kg PO ₄ -Eq./lamp(s)]	0.0010	0.0006	0.0008
Eutrophication Potential for usage [kg PO ₄ -Eq./lamp(s)]	0.137	0.027	0.027
Photochemical Ozone Creation Potential for manufacturing [kg Ethene-Eq./Lamp(s)]	0.0009	0.0007	0.0013
Photochemical Ozone Creation Potential for usage [kg Ethene-Eq./Lamp(s)]	0.20	0.04	0.04
Human Toxicity Potential for manufacturing [kg DCB-Eq./Lamp(s)]	0.52	0.71	0.94
Human Toxicity Potential for usage [kg DCB-Eq./Lamp(s)]	48.5	9.7	9.7
Abiotic Depletion Potential for manufacturing [kg Sb-Eq./Lamp(s)]	0.020	0.013	0.013
Abiotic Depletion Potential for usage [kg Sb-Eq./Lamp(s)]	2.87	0.57	0.57

Table 1 gives a clear picture of how electricity usage for lighting will affect the environmental properties. By using studies such as this, EU was convinced to phase-out incandescent light bulbs.

Global Warming Potential by using kg CO₂-Eq (kilogram of carbon dioxide equivalent) indicates the impact from GLS. Similar trend is also seen in all the other parameters that are used to determine overall environmental impact.

1.3 MALAYSIA'S JUSTIFICATION TO PHASE-OUT GLS

ST estimates that about 20% of the lamps used in Malaysia are of the incandescent type (GLS). It is estimated that about 15 million incandescent bulbs are sold annually in the country. Based on the assumption that the incandescent bulbs have an average rating of 60 Watt and all of them are replaced with 11 Watt CFLs with an average of 4 hours of daily operation, the total annual energy savings is about 1,074 GWh. This is equivalent to about 1.0% of the total national energy consumption and a saving of RM336 million in electricity consumption expenditure by consumers in this country. From the aspect of green house gas emissions, based on the assumption of lamp conversion as stated above, a total reduction of 732,000 tonnes of carbon dioxide, equivalent to 0.25% of the total annual quantity of carbon dioxide released in Malaysia can be achieved [4].

Based on AWER's research and consultations, this (reference [4]) is the only documentation on GLS phase-out programme by Malaysian government. AWER has conducted a consultation with ST on this matter. The phase out is still as scheduled on January 2014 and the relevant regulations are now in the process of being vetted by Attorney General's (AG) office. However, there is a delay from the actual planning in phase-out process due to the delay in AG's office.

This delay has also allowed many unwanted issues mushrooming quickly in Malaysia. Our study will highlight the core issues that need to be addressed to ensure a proper phase-out programme and preventing Malaysia to be a dumping ground of unwanted products. This is mainly because a lot of GLS phase-out programmes are already being implemented in many parts of the world with strict guidelines and regulations. Malaysia must ensure the products in our market are of good quality and performance.



PART 2: Challenges in phasing-out GLS

2.1 IMPACT TO SUPPLY AND DEMAND OF LIGHTING PRODUCTS

A phase-out process will remove inefficient products and will replace it with a suitable and efficient product. CFL has been identified as a suitable candidate to replace GLS. In addition to that, LED lights are also slowly taking up market share.

Such an immediate change globally has imposed supply-demand equilibrium risk. This might end up unfavourable for countries like Malaysia. Based on International Energy Agency (IEA) [1] study, the following conclusion can be made:

- (i) Demand for regulatory compliant lamps might increase too rapidly for the industry and supply chain to be able to satisfy it;
- (ii) Additional demand might be short-lived and therefore industry may have little economic incentive to invest in the necessary production facilities required to meet the peak demand;
- (iii) Demand for the lamp sales volumes could be met but that the quality of the available lamps is insufficient to satisfy consumer expectations.

A peak demand occurs due to shift from GLS to other types of lighting products by regulatory needs. Once this demand is met, sales will drop to a much lower value due to long operational life of CFL and LED. Will mass production bring down prices of these products as promised by the manufacturers? Only time will tell and differentiate ethical businessmen from others.

This also calls for stringent regulation to be put in place in Malaysia to ensure product's quality is also maintained. ***Lower quality of products will increase waste generation which defeats the primary purpose of phase-out programme that is environmental protection.***

2.2 CORRECT PHASE-OUT PROGRAMME ANNOUNCEMENT

In Malaysia, the current phase-out programme announcement did not identify the function of other types of lighting products such as fluorescent tubes, halogen bulbs, and efficient incandescent bulbs (improved halogen bulbs).

In this phase-out programme, only GLS is being phased-out and the fluorescent tubes are actually better for lighting in many spaces. Currently, this announcement has caused fluorescent tubes to be mistakenly neglected or misunderstood. Halogen bulbs are also being phased-out in developed nations. Due to this, this inefficient version of halogen bulbs are emerging rapidly in Malaysian market simply because their existence in Malaysia is neither regulated nor blocked.

In fact, CFL is just the temporary solution. For example, Chlorofluorocarbon (CFC) became the most wanted culprit due to ozone layer depletion. The CFC was replaced with hydrochlorofluorocarbon (HCFC), which is a transition solution for the problem. The actual solution was hydrocarbon (HC) based refrigerant. In other words, CFL and LED might not be the ultimate solution for lighting technology.

Therefore, communication to the public must be clear and educating. Confusing statements and jargons will leave the public perplexed and not knowing which way to move. This will also cause rejection from them or they will get tired of the so called "new" and "greener" solution policies.

2.3 PRODUCT INFORMATION

Information about a product is mainly published on the packaging of the product or addition leaflet which is placed inside the packaging. Unfortunately, various products have flocked the market and create confusion among users.

Based on our product sampling for CFL, some of the product information problems are as following:

- (i) Wrong information,
- (ii) Fake energy label,
- (iii) No manufacturer's details,
- (iv) Wrong claims, and
- (v) Doubtful health claims.

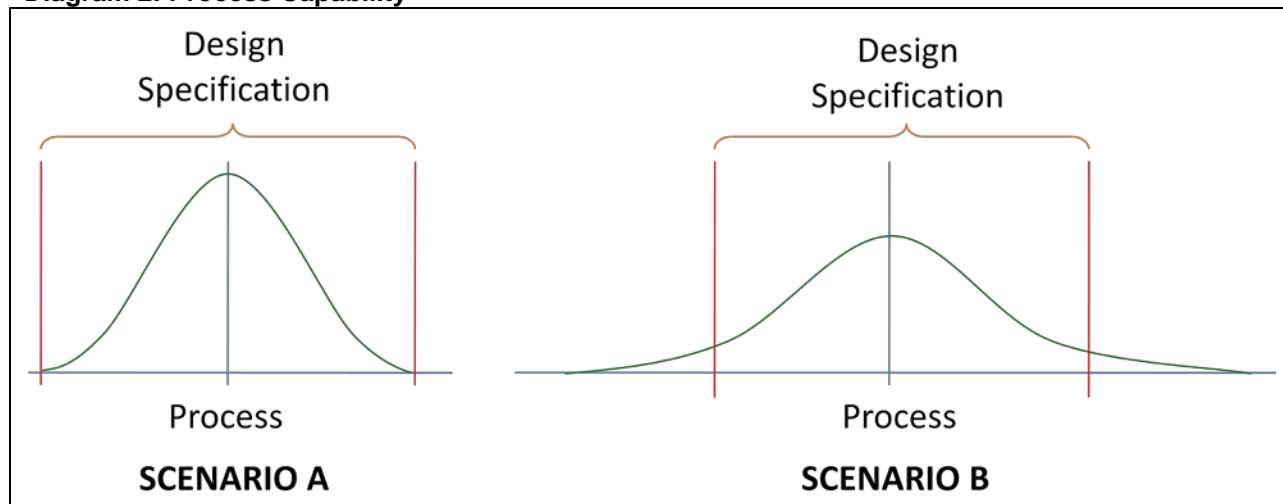
This issue will be discussed in detail in Part 3 of the report.

2.4 PRODUCT QUALITY

Due to peaking demand for CFL worldwide, quality of products that meets the demand will always be an issue. In any production line, normal distribution is applied to ensure product quality is maintained in a preferable 'bell curve' that fits design specification. In the age of achieving quality via 6-sigma (6σ), internationally it is expected that low quality of CFL will hit the market if proper regulations are not put in place. In Malaysia, there have been many cases where 'branded' CFL do not even last a year in operation. Now what guarantee the manufacturer can give to users to ensure quality of product is maintained while meeting the demand?

Diagram 2 (page 10) shows capability of a production process. Scenario A shows where high conformance of products' specifications are achieved compared to Scenario B. The operational cost of maintaining Scenario A is always higher compared to Scenario B. This also means, when a manufacturer promises a particular product performance, they must also ensure high percentage of their products can achieve the mentioned specifications based on Scenario A.

Diagram 2: Process Capability



2.5 PRICING OF CFL IS VAGUE

Retail price of CFL did not reduce much even after Malaysian government announced phase-out programme in year 2010. In this phase-out programme, the government is removing a huge market share of a cheaply priced competitor (GLS) to CFL by 2014. In addition to that, duty exemption benefits were also given for energy efficient lighting. Unfortunately, the price of these products has not reduced much. On the other hand, the phase-out programme announcement has also benefited some CFL products that are sold as low as RM 3.00. The quality of these products is also questionable. Furthermore, some established brands of CFL have higher retail price in supermarket and hypermarket compared to lighting shops which offer almost half of the price. Now, are Malaysians being short-changed?

2.6 HAZARDOUS WASTE MANAGEMENT

The mercury content in the fluorescent technology is nothing new. The CFL inherit the similar mercury content problem. Under the Environmental Quality Act 1974 (EQA), mercury in products and processes must be disposed safely as it is classified as one of the scheduled waste. Unfortunately, domestic users are not bound by this rule.

For example, if a domestic user disposes CFL into waste bin, it will be collected as garbage (solid waste). Once the waste collector collects the CFL from the waste bin, it becomes scheduled waste as business entities are regulated under EQA. Now, will the waste collection companies dispose the CFL via prescribed method or 'close one eye' and leave it to be buried in landfill?

The Scheduled Waste (or also known as Hazardous Waste) management is vital to be put in place before full scale phase-out of GLS. ***Without proper waste management mechanism, shifting to CFL is not environmentally friendly.***



PART 3: CFL Market Sampling Study

3.1 CFL MARKET SAMPLING STUDY

AWER has purchased various brands of CFL in order to represent a sizable sample of CFL in Malaysian market. There are a huge variety of brands, claims, labels, and symbols to confuse the end users before they make a choice to purchase.

For example, a reputable and very expensive brand claims to have CFL take back system (collect back the used CFLs directly) but in reality it does not. There is also a claim that CFL can increase health of a person. AWER's study looks into packaging, claims made, fake labels, misleading information as well as in-house testing by AWER for Power (unit is *Watt*) and Current (unit is *Ampere*). A total of 39 CFL samples were purchased from different locations and studied on predetermined parameters to conclude the study.

3.1.1 Product Information Study

Products such as CFL must carry basic information to ensure end users are not short changed. In this study, we used 3 good examples of CFL packaging and labelling information to do a comparative study. However, many parameters were dropped as most of the products in Malaysia market do not carry sufficient information. Therefore, AWER used very basic parameters to carry out this comparative study for product information. The selected parameters are:

- (i) Operating hour
- (ii) Label and symbols
 - a. Mercury content
 - b. Waste disposal
 - c. Usage of foreign energy efficiency rating
- (iii) Power, voltage and brightness component
- (iv) Product manufacturing and retailer information
 - a. Product made in which country
 - b. Company details

The findings of the study is summarised in Table 2. Only very few products gave sufficient information on the product packaging. There were few products which had different Power (Watt) value printed on the packaging and the product itself. Such confusion and misrepresentation should not occur at all.

Table 2: Summary of Product Information Study

Specimen	Brand	Operating hour (h)	Labels / symbols				Power / Voltage details	Product manufacturing and retailer information		Remarks
			Mercury content	Waste disposal	Energy Efficiency rating			Made in	Company details	
					Country	True / False				
S1cfl	Newmark	8000	No	No	-	-	C	No	No	
S2cfl	Allight	6000	No	No	-	-	P	No	Yes	
S3cfl	Pan Master	8000	No	No	EU	False	P	No	Partial	Detachable lights
S4cfl	IRS	-	No	No	EU	False	C	No	No	
S5cfl	Pensonic	8000	No	No	-	-	C	No	Yes	
S6cfl	Panasonic	6000	No	No	-	-	C	Yes	Yes	
S7cfl	Chomg	8000	No	No	China	False	P	No	Yes	Power value vague
S8cfl	Xierma	-	No	No	-	-	I	Yes	Fake	Health benefit claims
S9cfl	Scope	-	No	No	-	-	P	No	Yes	
S10cfl	Qusun	8000	No	No	-	-	P	No	No	Eye protection claim
S11cfl	Sefer	-	No	Yes	-	-	C	No	No	
S12cfl	EPS Ecotone	-	No	No	-	-	P	No	No	
S13cfl	Eurolite	8000	No	No	EU	False	P	No	No	
S14cfl	U-light	6000	No	No	-	-	C	No	No	
S15cfl	U2-light	6000	No	No	-	-	C	No	No	
S16cfl	Sylvania (Thailand)	8000	No	No	EU	False	C	Yes	Yes	
S17cfl	Vekocy	8000	No	No	EU	False	C	No	No	
S18cfl	Giant	6000	No	No	-	-	C	Yes	Yes	
S19cfl	Imitos	8000	No	Yes	-	-	C	No	Yes	
S20cfl	Universal	8000	No	No	-	-	C	Yes	No	
S21cfl	MK Light	8000	No	No	-	-	P	No	No	
S22cfl	Energy Saving	10000	No	Yes	EU	False	C	Yes	No	

(Table 2 Continued)

Table 2 Continued

Specimen	Brand	Operating hour (h)	Labels / symbols				Power / Voltage details*	Product manufacturing and retailer information		Remarks
			Mercury content	Waste disposal	Energy Efficiency rating			Made in	Company details	
					Country	True / False				
S23cfl	Arex	-	No	No	-	-	C	No	No	
S24cfl	Lotus	6000	No	No	-	-	C	No	No	
S25cfl	Tesco	8000	No	No	-	-	C	Yes	Yes	
S26cfl	Kunpeng	8000	No	No	Unknown	False	C	Yes	No	
S27cfl	Hongyao	8000	No	Yes	EU	False	P	No	No	Power value vague
S28cfl	Carrefour	8000	No	No	-	-	C	Yes	Yes	
S29cfl	Economy Hongyao	8000	No	No	EU	False	P	Yes	No	Power value vague
S30cfl	SANQ	10000	No	No	EU	False	C	Yes	No	
S31cfl	Osram	8000	No	No	-	-	C	Yes	Yes	Warranty card
S32cfl	Sunlife	8000	No	Yes	EU	False	P	No	No	
S33cfl	K2	8000	No	No	EU	False	P	No	No	
S34cfl	J-Flash	8000	No	Yes	EU	False	P	No	No	Power value vague
S35cfl	Philips (1)	15000	No	Yes	-	-	C	Yes	Yes	Security label issue
S36cfl	Philips (2)	8000	No	Yes	-	-	C	Yes	Yes	Security label issue
S37cfl	IKEA Sparsam (1)	6000	Yes	Yes	EU	True	C	Yes	Yes	Good example
S38cfl	IKEA Sparsam (2)	10000	Yes	Yes	EU	True	C	Yes	Yes	Good example
S39cfl	Megaman	10000	Yes	Yes	EU	True	C	Yes	Yes	Take back system claim

(*C = Complete, P = Partial, I = Incomplete)

3.1.2 Product Function Study

39 samples of products are tested for Power (Watt) and Current (miliAmpere) values to determine the claimed values printed on the packaging. This part of the study is to ensure the products are operating at claimed Power value. Under declaring or over declaring the power consumption will affect the comfortability during usage. Hidden cost of electricity and functionality issues will also occur if the product is under or over declared and used in large quantities.

During the in-house testing by AWER, CFL product is fixed to its suitable socket and will be lit for 1 hour. The value of following parameters are recorded during the test:

- (i) Current (miliAmpere / mA)
- (ii) Power (Watt / W)
- (iii) Lowest Power value (Watt / W)
- (iv) Highest Power value (Watt / W)

Based on the stable Power value, we calculated the Tested Power Difference (in percentage). This is done via the following formula:

Tested Power Difference (in percentage)

$$= \frac{\text{Tested Power value} - \text{Claimed Power value}}{\text{Claimed Power value}} \times 100\%$$

The difference can be in either positive or negative value. Difference more than 10% should not be accepted as it causes the product to be either over or under declared. In our study, a large number of CFL products' Power value difference is more than 20%.

3.1.3 Summary of CFL Market Sampling Study

AWER has given marks to the tested CFL specimens based on performance in selected parameters. Label rating, power / voltage information rating and tested power difference are primary rating parameters. In addition to that, additional points are given to products with good example and points are deducted for wrongful claims. Based on the selected parameters, only 15 out of 39 specimens tested received positive rating. This rating is only a baseline rating. Once the government imposes full scale guidelines and standards for CFL packaging, labelling and performance, AWER would conduct another full scale rating and ranking.

This study is to give an overview of the problems related to CFL products in Malaysian market. For example, specimen S35cfl and S36cfl (Figure 6) are from Philips brand and had two different security labels. This will confuse the public. We used the URL given in the label of S35cfl (www.philips.com/authenticity) to verify the label and it was certified as genuine product as shown in Figure 7. Meanwhile, the specimen S36cfl is sold in a

reputable local hypermarket and do not have any detection method. We have communicated with Philips Malaysia to get clarification on the labels. They replied that both the labels as genuine label. Based on our study, specimen S36cfl has a higher power value difference compared to specimen S35cfl. Now, which one is a genuine product? How would a lay person identify it? We hope proper and uniform mechanism will be put in place by the manufacturers and retailers themselves to prevent fake products in the market.

Figure 6: Philips Security Label samples studied



Figure 7: Authenticity Result Display for Philips Product



Besides this, there is also rampant usage of fake EU Energy Efficiency rating label. AWER managed to get the assistance from the Directorate-General for Energy, European Commission to identify the fake labels and false labels using the Commission Directive 98/11/EC [5]. Figure 8 shows correct EU energy efficiency rating labels, while, Figure 9 shows fake EU energy efficiency rating labels.

Figure 8:
Correct EU Energy Efficiency Rating labels

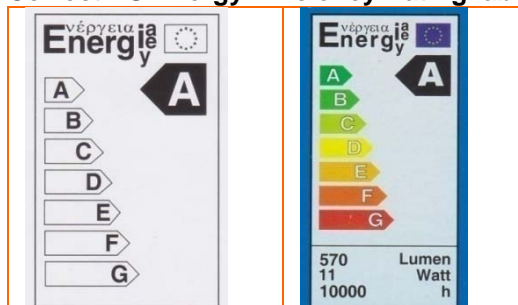
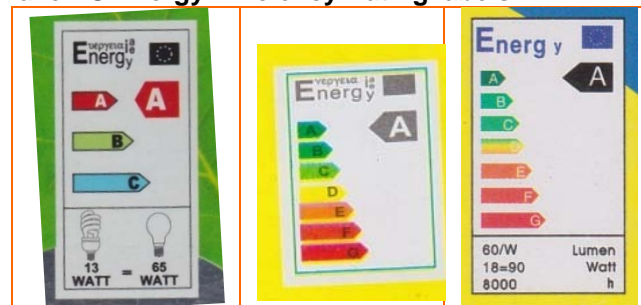


Figure 9:
Fake EU Energy Efficiency Rating labels



3.2 COMPARISON WITH VARIOUS TYPES OF LIGHT BULBS

3.2.1 Light Bulb Operation Cost

If a user uses a light bulb for 5 hours a day and assuming operating hour data provided by manufacturers are correct, what will be the cost analysis of the operation cost of usage of different type of light bulbs? In this study, we assume only 80% of service life (Operating Hours) of a bulb is achieved.

Table 3: Lighting Product Operation Cost Comparison

Product	GLS	Halogen (D Class)	CFL	LED
Operating Hours	1,000	2,000	6,000 – 10,000	25,000
Discounted Operating hours	800	1,600	4,800 – 8,000	20,000
Number of replacement*	25 times	13 times (12.5)	4 times (4.2 – 2.5)	-
Average cost of products** (RM)	1.90	7.45 (5.99 – 8.90)	20.00 (15.00 – 25.00)	85.00 (70.00 – 100.00)
Part 1: total cost of bulb [including replacement] (RM)	47.50	96.85	80.00	85.00
Rated Power consumption (Watt / W)	25	18	5	5
Part 2: Cost of Power consumption for 20,000 hours *** (RM)	109.00	78.48	21.80	21.80
Total cost (RM) = Part 1 + Part 2	156.50	175.33	101.80	106.80
If a GLS bulb is replaced, what is the saving in 20,000 hours operation? (RM)	-	Waste RM18.83	Save RM 54.70	Save RM 49.70

* Must be a round figure comparatively to LED

** Assume there is no variation of cost of purchase (using average cost) based on AWER's Market Study

*** Cost of electricity is RM 0.218 / kWh

Table 3 gives a rough idea of operational costing for different type of light bulbs. If we take 20,000 hours for operation of a light bulb, it means that we use it for 10 years 11 months 15 days and few more hours when we switch it on for 5 hours daily. In this calculation, AWER fixed the electricity cost and light bulb cost to give a static impression of the comparison. This is because other types of products would not have increase in demand if GLS is not removed from market. The current trend also shows that price of certain favoured CFL are slowly increasing compared to previous years. Shifting to CFL and LED bulbs has relative savings compared to halogen bulbs. In other words, with large operations the savings are better.

3.2.2 Carbon Footprint of Lighting Product

If a user uses these products for 20,000 hours, what will the carbon footprint be? Table 4 shows that the carbon footprint of CFL and LED is way lower compared to GLS and Halogen (D Class). This is exactly what removal of inefficient product should be achieving. There are few methods like carbon tax and evaluation method to calculate this environmental cost. Such mechanism does not exist in Malaysia.

Table 4: Carbon Footprint Comparison of Lighting Product

Product	GLS	Halogen (D Class)	CFL	LED
Rated Power consumption (Watt / W)	25	18	5	5
Total power consumption (kWh)	500	360	100	100
Carbon footprint in kg CO ₂ equivalent*	335.0	241.2	67.0	67.0
Differences in carbon footprint (%)	-	28	80	80

* 1 kWh produces 0.67 kg CO₂ equivalent

3.2.3 Conclusion of Comparison

- (i) When savings of electricity usage cost and environmental factors are added together, the phase out of GLS is justified. However, this is only valid with **proper handling of mercury content in CFL during disposal stage**.
- (ii) Halogen lights of lower efficiency do not give any significant impact in both costs saving as well as environmental impact. These light bulbs should not be allowed in Malaysian market.
- (iii) Based on AWER's study, CFL is a transition solution to energy efficient lighting. This also means that LED or any other lighting technologies will eventually be a better solution compared to CFL. However, LED technology is still going through a rapid development and it will take some time for the technology to reach its peak to be cost effective and reach the mass.



PART 4: Recommendations

4.0 RECOMMENDATIONS

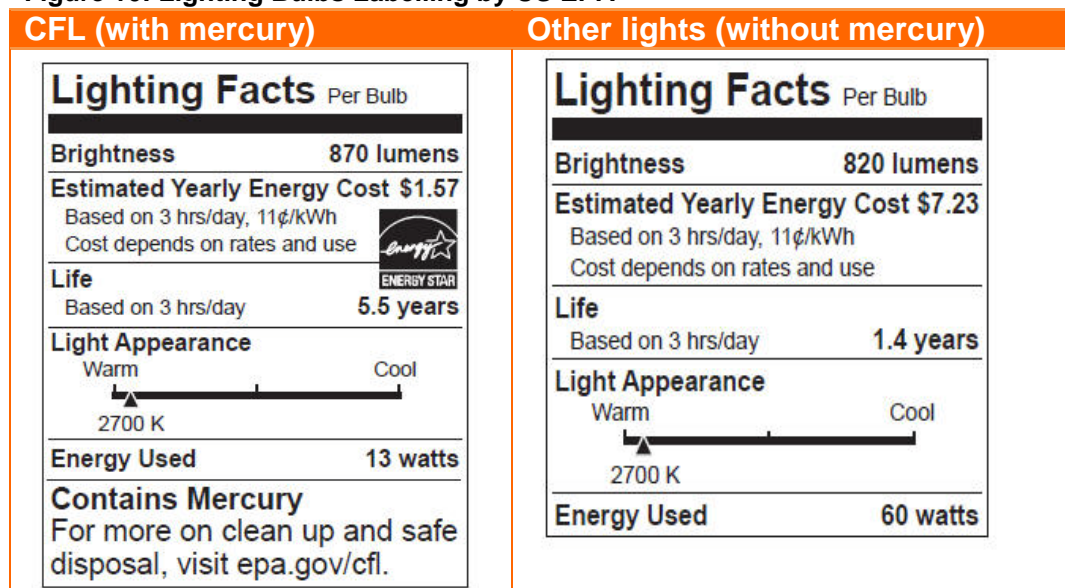
Based on the findings via our study, the GLS phase-out needs more careful planning to prevent unwanted problems in Malaysia. The following recommendations from AWER will be forwarded to ST, KeTTHA and other relevant agencies. AWER will monitor the implementation of the recommendations as a Key Performance Index set by us for both ST and KeTTHA.

4.1 Standard, Testing and Labelling

Based on our consultation with ST, the regulations for GLS phase-out and CFL testing are still with the AG's office. Delay in approving regulations or guidelines will only give serious negative impact to the implementation of phase-out process which should fully take place by year 2014.

All lighting products sold in the market must be labelled uniformly to assist end users to be able to compare product functions easily. For example, the US EPA has introduced a uniform labelling as shown in Figure 10. The samples below not only differentiate those with and without mercury content, they also provides standard life (operating hours) for a lighting products and cost comparison. Currently, Malaysia does not have any such standard label in place.

Figure 10: Lighting Bulbs Labelling by US EPA



AWER would like to propose that the following information to be included in the product packaging and regulated as a mandatory requirement:

- (i) **Energy efficiency rating** - the 5 Star rating system can be used to identify energy efficiency and efficacy for all types of lighting products.
- (ii) **Mercury content** - lighting product such as CFL have mercury content. This must be highlighted via suitable label and symbols.
- (iii) **Light output** - the light output in Lumens must be included in the labelling.
- (iv) **Rated Power consumption** - there should be a 'normal distribution' target set to achieve proper number of products that meets rated power consumption (which is claimed in the label). High difference causes higher power consumption or low light output without the knowledge of the users.
- (v) **Operating hours** - a standard calculation to determine life span (total years) a product can operate must be developed. Currently, many well known lighting products do mislead the users by giving high claims in life span by cheating in the calculation of operating hours.
- (vi) **Colour of light** - type of lighting must be mentioned. This is to allow end users to purchase correct and suitable product that meets their requirements.
- (vii) **Number of switches before failure** - total number of switching on and off must be defined to identify the durability of the product. Lower end CFL product spoils faster with more switching on and off as reported in some of the studies during the EU phase-out period.
- (viii) **Warm-up time taken** - there are some lighting products come with slow starter. For example, mercury in the form of amalgam takes longer time to stabilise in a CFL. There are also older versions of CFL with normal mercury type stabilise slower. This is not necessarily a defect but it is mere technology issue. Such a situation must be defined and should be limited to not more than 60 seconds.
- (ix) **Dimming property** - most CFL are not dimmable. However, there are new CFL models that can be dimmed in the market. The dimmable property must be defined in the packaging to ensure end users purchase correct products.
- (x) **Operating temperature and condition** - not all CFL can be used in all locations with different working temperature and condition. Therefore, limitations like this must be defined clearly to avoid unwanted incidents.
- (xi) **Disposal of lamp** - CFL lamps cannot be disposed off directly to the waste bins. Under the EQA, mercury is defined as scheduled waste. The moment waste management companies collect them from domestic users or disposed

by any commercial and industrial users, this material must go through a recovery process and disposed properly. There must be a clear indication on the packaging on the disposal requirement.

- (xii) **Estimated operating cost** - with reference to the US EPA method of labelling for lighting products, estimated operating cost is given with standardised parameters. This is a more effective way to represent impact of energy efficiency to the end users.

4.2 In-Flow of Halogen Bulbs

Halogen bulbs are in the process of being phased-out by EU. The C class and D class (the class is based on EU energy efficiency labelling) will be phased-out by year 2016. However, there is a sudden in flow of these bulbs in Malaysian market. In addition to that, the halogen bulbs that are in B class are still having technical problems. Based on AWER's study, we do not see this technology as a potential replacement for GLS as the core technology for emitting light is similar to GLS. ***We urge the ST to prevent double phase-out attempts by banning halogen bulbs sales here with immediate effect.***

4.3 Waste Management

Waste management of CFL is still in dark. The EQA via Environment Quality (Scheduled Waste) Regulation 2005 classify mercury waste as SW109. The disposal of CFL and the fluorescent tubes are not classified as E-Waste (Electronic Waste). They are currently being disposed directly to waste bins. Once the waste collector collects it, the responsibility is under the waste collector to dispose it accordingly. In addition to that, any contamination to other type of normal waste with scheduled waste will need specific disposal. In other word, if a CFL breaks in a waste bin or waste collection lorry, the entire waste needs to be treated as part of scheduled waste. However, this is not practised in Malaysia and such a problem must be rectified before full implementation of GLS phase-out.

AWER would like to suggest a 'take-back' policy to be implemented via the retailers and manufacturers. As per our discussion with DOE and JPSPN, a detailed waste management solution will be outlined by AWER to give input and proposal to both agencies.

4.4 Assisting Financially Challenged Groups

The lower income group are AWER's immediate concern. When they replace a GLS, they do not spend anything above RM 3.00. However, CFL unit is way too expensive for them to make an immediate replacement. Based on some of our surveys with users that have already opted to CFL, the product they use sometimes do not even last 1 year of operation even though it is a branded product. If such a situation occurs, the replacement cost will deter many middle income groups as well. Therefore, quality of CFL must be addressed by ST immediately. In addition to that, the government must

also develop a proper financial mechanism to assist the financially challenged groups because these people are left with no choice with government's decision to phase-out GLS.

4.5 Preventing Cartel and Profiteering

The phase-out of GLS is to remove high carbon footprint technology and replace it with lower carbon footprint technology such as CFL. Therefore, with reduction in market competition, the CFL price should be reduced. Unfortunately, this does not take place. AWER has purchased a genuine branded product in a location in Negeri Sembilan for RM 8.00 and the similar product is sold in few hypermarkets at a price that is above RM 16.00. Now, are consumers being short-changed?

In addition to that, the purchasing cost of house brands CFL that are carried by local hypermarkets are always cheaper than the branded CFL. Does this mean that the cheaper house brands are of worst quality compared to premium brands? Definitely this would not be the situation. It can only mean that there is element of cartel and profiteering. Therefore, AWER urges Malaysian Competition Commission (MyCC) to carry out an investigation on this matter. ***This would be the first Key Performance Index set by AWER for MyCC and they must release the investigation report by end of December 2012 for public knowledge.***

4.6 Continuous Monitoring and Enforcement

Regulations that are supposed to be carried out have been delayed as it is still with the Attorney General's office (information during our meeting in fourth quarter of 2011). We urge ST to increase the speed of preparation of standard, labelling, regulations, guidelines, etc to assist them in continuous monitoring and enforcement.

AWER will continue to follow up with ST on this matter to ensure our recommendations are implemented properly and the problems are rectified as soon as possible.



PART 5: Guideline to Users

5.1 INFORMATION TO LOOK FOR DURING CFL PURCHASE

- (i) **Company information** - Ensure you check the company's contact details on the packaging before purchasing. Do verify with the retailers on the information given. If the retailers are not sure of the information, you can make the choice of not purchasing it.
- (ii) **Energy efficiency and cost** - Check for Power (Watt) value displayed in the product's packaging. You can use Click d' Thief, a Low CO2 Tool developed by AWER at www.click.org.my to identify the power consumption, its carbon footprint as well as cost of electricity. It is better to compare prices and products as not all expensive products are of better quality and energy efficient.
- (iii) **Mercury content and disposal** - CFL contains Mercury which is detrimental to human health. You must read the packaging for information related to mercury content and disposal. Do alert us via general@awer.org.my if you find doubtful information.
- (iv) **Operating hours** - Do not get carried away with claims of long life of lighting products. The product packaging must carry the operational hours for each product. For example, if a CFL is claimed to operate for 8000 hours, what does this exactly mean to you? If you are using this bulb for 6 hours a day, the total operational year is:

$$\text{Operational year} = \frac{8000 \text{ hours}}{6 \text{ hours} \times 365 \text{ days}}$$

$$= 3.65 \text{ years or } 3 \text{ years and } 237 \text{ days}$$

If your use the CFL for longer hours, the operational year will be shorter. So beware of claims on the product's packaging.
- (v) **Functions** - Must check information on lighting colour, warm-up time, dimmable or non-dimmable, and the CFL's operational condition. Most CFL in Malaysian market are non-dimmable. Choose them carefully.
- (vi) **Cross check** - If you have doubts about CFL in the market, do not hesitate to either communicate to us or the relevant government agencies (ST or KeTTHA). Do check out the labels of 'doubtful' products that AWER has published in the special report.

5.2 BROKEN CFL BULB CLEANUP

[This section is published with written permission from United States Environment Protection Agency (US EPA) – 04th November 2011].

Fluorescent light bulbs contain a small amount of mercury sealed within the glass tubing. When a fluorescent bulb breaks in your home, some of this mercury is released as mercury vapour. The broken bulb can continue to release mercury vapour until it is cleaned up and removed from the residence.

To minimize exposure to mercury vapour, EPA recommends that residents follow the cleanup and disposal steps described below. This cleanup guidance represents the minimum actions recommended to clean up a broken CFL, and will be updated as EPA identifies more effective cleanup practices.

CLEANUP AND DISPOSAL OVERVIEW

The most important steps to reduce exposure to mercury vapour from a broken bulb are:

I. Before cleanup

- a. Have people and pets leave the room.
- b. Air out the room for 5 – 10 minutes by opening a window or door to the outdoor environment.
- c. Shut off the central forced air heating/air conditioning system, if you have one.
- d. Collect materials needed to clean up broken bulbs.

II. During cleanup

- a. Be thorough in collecting broken glass and visible powder.
- b. Place cleanup materials in a sealable container.

III. After cleanup

- a. Promptly place all bulb debris and cleanup materials in a trash container or protected area until materials can be disposed of properly. Avoid leaving any bulb fragments or cleanup materials indoors.
- b. If practical, continue to air out the room where the bulb was broken and leave the heating / air conditioning system shut off for several hours.

5.2.1 Before Cleanup

- Have people and pets leave the room, and avoid the breakage area on the way out.
- Open a window or door to the outdoors and leave the room for 5-10 minutes.
- Shut off the central forced-air heating/air conditioning (H&AC) system, if you have one.
- Collect materials you will need to clean up the broken bulb:
 - Stiff paper or cardboard
 - Sticky tape (e.g., duct tape)
 - Damp paper towels or disposable wet wipes (for hard surfaces)

- Glass jar with a metal lid (such as a canning jar) or a sealable plastic bag(s)

5.2.2 Cleanup Steps for Hard Surfaces

- Carefully scoop up glass fragments and powder using stiff paper or cardboard and place debris and paper/cardboard in a glass jar with a metal lid. If a glass jar is not available, use a sealable plastic bag. *(NOTE: Since a plastic bag will not prevent the mercury vapour from escaping, remove the plastic bag(s) from the home after cleanup.)*
- Use sticky tape, such as duct tape, to pick up any remaining small glass fragments and powder. Place the used tape in the glass jar or plastic bag.
- Wipe the area clean with damp paper towels or disposable wet wipes. Place the towels in the glass jar or plastic bag.
- Vacuuming of hard surfaces during cleanup is not recommended unless broken glass remains after all other cleanup steps have been taken. *[NOTE: It is possible that vacuuming could spread mercury- containing powder or mercury vapour, although available information on this problem is limited.]*
- If vacuuming is needed to ensure removal of all broken glass, keep the following tips in mind:
 - Keep a window or door to the outdoors open;
 - Vacuum the area where the bulb was broken using the vacuum hose, if available; and
 - Remove the vacuum bag (or empty and wipe the canister) and seal the bag/vacuum debris, and any materials used to clean the vacuum, in a plastic bag.
- Promptly place all bulb debris and cleanup materials, including vacuum cleaner bags, outdoors in a trash container or protected area until materials can be disposed of properly.
- Check with your local or state government about disposal requirements in your area. Some states and communities require fluorescent bulbs (broken or unbroken) be taken to a local recycling centre.
- Wash your hands with soap and water after disposing of the jars or plastic bags containing bulb debris and cleanup materials.
- Continue to air out the room where the bulb was broken and leave the H&AC system shut off, as practical, for several hours.

5.2.3 Cleanup Steps for Carpeting or Rugs

- Carefully scoop up glass fragments and powder using stiff paper or cardboard and place debris and paper/cardboard in a glass jar with a metal lid. If a glass jar is not available, use a sealable plastic bag. *(NOTE: Since a plastic bag will not prevent the mercury vapour from escaping, remove the plastic bag(s) from the home after cleanup.)*
- Use sticky tape, such as duct tape, to pick up any remaining small glass fragments and powder. Place the used tape in the glass jar or plastic bag.

- Vacuuming of carpeting or rugs during cleanup is not recommended unless broken glass remains after all other cleanup steps have been taken.*[NOTE: It is possible that vacuuming could spread mercury-containing powder or mercury vapour, although available information on this problem is limited.]*
- If vacuuming is needed to ensure removal of all broken glass, keep the following tips in mind:
 - Keep a window or door to the outdoors open;
 - Vacuum the area where the bulb was broken using the vacuum hose, if available, and
 - Remove the vacuum bag (or empty and wipe the canister) and seal the bag/vacuum debris, and any materials used to clean the vacuum, in a plastic bag.
- Promptly place all bulb debris and cleanup materials, including vacuum cleaner bags, outdoors in a trash container or protected area until materials can be disposed of properly.
- Check with your local or state government about disposal requirements in your area. Some states and communities require fluorescent bulbs (broken or unbroken) be taken to a local recycling centre.
- Wash your hands with soap and water after disposing of the jars or plastic bags containing bulb debris and cleanup materials.
- Continue to air out the room where the bulb was broken and leave the H&AC system shut off, as practical, for several hours.

5.2.4 Future Cleaning if Carpeting or Rugs: Air Out The Room During and After Vacuuming

- The next several times you vacuum the rug or carpet, shut off the H&AC system if you have one, close the doors to other rooms, and open a window or door to the outside before vacuuming. Change the vacuum bag after each use in this area.
- After vacuuming is completed, keep the H&AC system shut off and the window or door to the outside open, as practical, for several hours.

5.2.5 Actions You Can Take to Prevent Broken Compact Fluorescent Light Bulbs

- Fluorescent bulbs are made of glass and can break if dropped or roughly handled. To avoid breaking a bulb, follow these general practices:
 - Always switch off and allow a working CFL bulb to cool before handling.
 - Always handle CFL bulbs carefully to avoid breakage.
 - If possible, screw/unscrew the CFL by holding the plastic or ceramic base, not the glass tubing.
 - Gently screw in the CFL until snug. Do not over-tighten.
 - Never forcefully twist the glass tubing.

- Consider not using CFLs in lamps that can be easily knocked over, in unprotected light fixtures, or in lamps that are incompatible with the spiral or folded shape of many CFLs.
- Do not use CFL bulbs in locations where they can easily be broken, such as play spaces.
- Use CFL bulbs that have a glass or plastic cover over the spiral or folded glass tube, if available. These types of bulbs look more like incandescent bulbs and may be more durable if dropped.
- Consider using a drop cloth (e.g., plastic sheet or beach towel) when changing a fluorescent light bulb in case a breakage should occur. The drop cloth will help prevent mercury contamination of nearby surfaces and can be bundled with the bulb debris for disposal.



PART 6: The Way Forward

In our study on the GLS phase-out programme, Energy Efficiency is the key component. However, it should not be at the expense of human health and environmental safety. Heavy metals are a concern to health and environmental degradation. Will we repeat the same mistakes recorded in history?

Beginning in the 1920s, lead (Plumbum - a heavy metal) was added to petrol (gasoline) to improve its combustion. This has caused increase in lead poisoning that affects children the most with many permanent damages. Since 1980s, blood lead levels have been declining sharply worldwide, when leaded gasoline began to be phased out. It took humans almost 60 years to realise this.

Phasing-out GLS introduces large in-flow of CFL bulbs with Mercury and till date there is no proper collection system for the waste generated in Malaysia. Improper disposal of CFL bulb may increase mercury contamination in surface water and groundwater. This could lead to cross contamination of water and food consumed by Malaysian. In addition to that, ambiguous CFL products are entering Malaysian market unchecked and sold without control. The impact, posed by such products is far greater due to very low purchase cost.

AWER has also found lighting products like halogen bulbs that will be phased-out by EU in year 2016 are entering our market. These products were not part and parcel of our lighting needs and two major world brands are already bringing these products to Malaysia. Why are we treated as a 'dumping ground'? These products are not energy efficient and we should not allow industries to 'clear their stocks' in Malaysia.

We urge the relevant agencies in Malaysia to take heed of our findings in this report to ensure we SWITCH IT RIGHT from the first time.



PART 7: Reference

REFERENCE

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