January 2009

Energy Commission

Final Report - CFL Exchange Programme Impact Assessment

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List of Acronyms

AGI	Association of Ghana Industries
CDM	Clean Development Mechanism
CFLs	Compact Fluorescent Lamps
CO_2	Carbon Dioxide
EC	Energy Commission
ECG	Electricity Company of Ghana
EF	Energy Foundation
EIA	Environmental Impact Assessment
GHGs	Green House Gas Emissions
EPA	Environmental Protection Agency
LCO	Light Crude Oil
MMDAs	Metropolitan, Municipal and District Assemblies
NED	Northern Electricity Department
PURC	Public Utility Regulatory Commission
TAPCO	Takoradi Power Company
TICO	Takoradi International Company
VRA	Volta River Authority

List of Units

bbl	Barrel
GW	Gigawatt
GWh	Gigawatt hour
Kg	Kilogram
$kgCO_2/kWh$	Kilogram of Carbon dioxide per Kilowatt hour
kW	Kilowatt
kWh	Kilowatt hour
lbs	Pounds
MW	Megawatt
US$/bbl	US Dollar per barrel
US$/ton	US Dollar per ton
W	Watts

Conversion

1 MW = 1000 kW

Executive Summary

The Energy Commission (EC) is mandated by section 2.2(b) of the Energy Commission Act 1997 (ACT 541) to "advise the Minister on national policies for the efficient, economical, and safe supply of electricity, natural gas and petroleum products having due regard to the national economy". This mandate seeks regard for the assessment of all energy policies and programmes to ensure health, environmental and safety concerns.

In August 2007, the Ministry of Energy launched the National Compact Fluorescent Exchange Programme at the peak of the nation's power crisis. It was expected that the programme would save the nation about 200-220MW of peak electricity supply. In accordance with its mandate, the Energy Commission conducted an impact assessment of the national programme from January – October 2008. The survey techniques applied were; statistical sampling procedures, stakeholder consultations, field verification of CFLs stock supplies, interviews of beneficiaries of the programme and GIS map production of CFLs distribution by district.

This report outlines the major achievements of the CFLs exchange programme:

- Peak load savings of 124MW or 172.8GWh/annum
- $C0_2$ savings of about 112,320 tons per annum
- Delay in thermal generation expansion investment of US$105 million
- Mean household income savings of about GH¢31.00 in 25 districts nationwide over six months and

- A reduction of 148, 000 barrels light crude oil for thermal electricity generation.

- At an average crude oil price of US$ 105 per barrel recorded between October 2007 – October 2008, the energy cost savings is estimated at US$ 33.3million per annum.

The report also highlights some of the setbacks of the programme these include;

- Lack of cooperation of major stakeholders in the planning and implementation of the exercise, due to the emergency nature of the intervention
- the oversight of environmental issues in the disposal of dead CFLs and the handling of the broken CFLs,
- Inadequate training for programme implementation team and
- Inadequate awareness creation on CFLs technology for household beneficiaries.

In conclusion, the report recommends an expansion of the CFLs exchange programme to scale up the peak electricity savings and other benefits such as CO_2 savings and investment delay in electricity generation expansion.

1.0 INTRODUCTION

The Ministry of Energy in August 2007 launched the National Compact Fluorescent Lamps (CFLs) exchange programme. The Ministry announced that the government had imported six million CFLs for distribution free of charge to all households in the country in exchange for incandescent bulbs. This was an emergency policy intervention measure to reduce peak electricity supply in order to resolve the power crisis, as a result of low rainfall which had affected hydro-electricity supply.

Earlier, in August 2006 the Volta River Authority (VRA) and the Energy Foundation had held a series of meetings and outlined measures to reduce electricity demand. The Foundation presented a report DOC1 which identified measures that combine technology, administrative measures, education and policy intervention to reduce electricity peak load.

In addition to the above measures, a CFLs exchange programme was introduced with the objective to replace six million incandescent lamps with an equivalent number of CFLs. The following outputs were targeted;

- Peak Electricity demand reduction from 200-220 MW.
- Stabilization of electricity grid system
- Elimination of brownout and transformer overloads
- Reduction of diesel and other thermal generators to supplement hydro and other cheaper power generation options

It is generally known that, a higher penetration of CFLs for household lighting could reduce growth in electricity demand, reduce fossil fuel use for thermal electricity generation and lessen environmental impacts.

1.1 Compact Fluorescent Lamps (CFLs) Technology

The compact fluorescent lamps as defined by the Electric Power Research Institute are lamps intended to replace the incandescent lamps and have an overall length of 20cm or less. The CFLs consist of two parts, gas-filled tube (bulb) and magnetic electronic ballast. CFLs require less energy input than incandescent lamps for example the 27 watts (W) CFL generates approximately 1800 lumens compared to 1750 lumens from 100 watts (W) incandescent. CFLs also have a significantly longer service life, 6000-15000 hrs compared to 750 – 1000 hrs for a standard incandescent lamp. The CFLs produce less heat and consequently reduce the need for cooling with fans and air conditioners which also consume electricity.

The compact fluorescent lamp therefore offers a considerable increase in energy efficiency compared to conventional incandescent lamps and has long been recognized as the quickest and surest way of reducing energy consumption particularly among residential consumers.

1.2 Global Experience

On the Global front a recent publication by Asia-Pacific Economic Cooperation on Energy Inefficient Light Bulbs indicated that nations are moving gradually towards more energy-efficient lighting and phasing out inefficient bulbs in an effort to reduce greenhouse gas emissions.

The first country in the world to phase out incandescent lamps is **Cuba. Cuba** implemented a massive market transformation effort to replace every single incandescent lamp in every socket in the country by a compact fluorescent lamp in 2006 and 2007.

Incandescent lamps are banned from sale and production. The country also replaced more than a million inefficient domestic refrigerators over the same period.

Oil rich **Venezuela** has also banned the use of incandescent lamps. **Australia** is phasing out incandescent lamps by 2009.

Other economies in Asia including **China, Thailand** and **Philippines** have introduced measures to promote the use of energy-saving bulbs instead of incandescent lighting. **India** is following another route to achieve the shift away from incandescent lighting, through a series of large-scale CDM (Clean Development Mechanism) projects under the recently approved programmatic approach. Government and utilities in **Egypt, Argentina, Indonesia, South Africa** and **Vietnam** are all considering similar options and strengthening existing major CFL promotional programs. Several other countries including **Brazil** and **Mexico** have previously launched successful large scale programmes to promote the use of CFLs. In the **USA**, California and Nevada have introduced legislation to phase out incandescent lamps and all the states in the USA are expected to phase out incandescent lamps by 2012.

This report presents the findings of the CFLs Impact Assessment study carried out in 2008 by the Energy Commission.

1.3 Objective

The objectives of the impact assessment were:

- To assess the coverage of the CFLs distribution among households in 138 districts of the country.
- To assess the perception of key stakeholders and households on the significance and expectations of the intervention.
- To assess the effectiveness of implementation strategy.
- To measure the effect on electricity peak load.
- To measure savings on income, investments and CO_2
- To provide information for policy review and future programme planning

2.0 METHODOLOGY

The impact assessment framework consisted selection of a sample and the use of field survey techniques.

2.1 Sampling Method

Given the number of households in the country as 4,200,000[1] and electricity grid customer population of 1,800,000[2], the sampling proportion was derived as follows:

The sampling proportion = 1,800,000 /4,200,000 =0.43

The survey sample was derived from the number of households in the country and total grid electricity customers. This became the preferred sample instead of using any other parameter such as standard deviation and population mean.

The allowable sampling error was set at 2.5% and the confidence level at 95%.

Using the formula

$$n = \frac{(Z)^2 (p)(q)}{E^2}$$

The table below summarizes the derivation of the sample size n. The derived sample size is 1505.

[1] Source: Ghana Statistical Service Census Report 2000
[2] Source: Electricity Company of Ghana 2007

Table 1: Sample Size Determination

Total household Population of Ghana	Electricity Grid Customer population	Sampling proportion (p)	q(1-p)
4,200,000.0	1,800,000.0	0.43	0.57

CL	CL^2	p	q	E	E^2	n
1.96	3.84	0.43	0.57	0.025	0.000625	1505.28

2.1.1 Sample size distribution

The sample size distribution with respect to income categories was done as follows:
Three income groups where 30% of the population belongs to low income, 50% to middle income and 20% to high income was worked out in a ratio of 3:5:2.

Given these ratios a stratified sample was established as shown below:

Table 2: Sample Size Distribution

Households with high income	0.2	301
Households with middle income	0.5	753
Households with low income	0.3	452
Total		1505

The sample sizes for the various regions is shown in table 3 below:

Table 3: Regional Sample Size

Region	Percentage of bulbs supplied	Total no. of respondents
Greater Accra	35.6	536
Western Region	10	151
Eastern Region	6.8	102
Central Region	6.7	101
Ashanti Region	17.5	263
Brong Ahafo	5.8	87
Volta Region	5.9	89
Northern Region	4.2	63
Upper East	4.2	63
Upper West	3.3	50
Total	**100**	**1505**

2 .2 Survey Techniques

The techniques used were:

- Examination of stock receipts and distribution records
- Interviews with stakeholder groups
- Interviews with project personnel
- Questionnaires administered to households
- Examination of CFLs replaced at individual households and incandescent bulbs collected
- Data collection on electricity peak load, demand and consumption from power utilities such as VRA, ECG and NED.

2.3 Assumptions:

1. Each household had an incandescent bulb replaced with a CFL.
2. Income levels among households vary directly with electricity consumption.

3. The variation in electricity consumption is expressed in the ratio 3:5:2 where 30% refers to households with low income, 50% to households with middle income and 20% to households with high income.

3.0 SOURCES OF INFORMATION

The data and information for the preparation of this report were gathered from households and key stakeholders of the energy sector.

3.1 Characteristics of Household Sample

Every household interviewed is identified by a billing meter. The sample consisted of 63% males and 37% females. In all 948 males were interviewed whilst 557 were females out of the total sample in all metropolis, municipalities and districts nationwide. The findings of the study therefore support a fair representation of gender.

Among the selected sample 29% belonged to the low income class, 53% to middle income and 18% were in the high income class. Most of the respondents therefore belonged to the middle income class.

The educational level of the sample selected was as follows: basic 26%, intermediate 36% and 27% for the tertiary level.

Types of dwelling units visited in this survey from the selected sample consisted of 32% single family detached, 24% single family attached, 40% compound houses, 3% storey buildings not exceeding four storey and 1% storey buildings exceeding four storeys.

Among households interviewed it was revealed that 55% of respondents were landlords, 31% tenants and 14% caretakers.

3.2 List of Stakeholders Interviewed

Table 4: List of Stakeholders Interviewed

List of Stakeholders	Information collected
Public Utilities Regulatory Commission	Tariff schedules
Electricity Company of Ghana	Electricity demand and consumption data
Volta River Authority	Daily peak loads, electricity demand and consumption data
Northern Electricity Department	Electricity demand and consumption data for Northern Ghana
Ministry of Energy	CFLs Programme Information
Energy Foundation	Programme implementation information
Metropolitan, Municipal and District Assemblies (MMDA's)	Household data, CFL stock receipts (supply) and waste disposal information.
Environmental Protection Agency	Information on environmental regulations of CFLs
Ghana Association of Electrical Contractors (GAEC)	Technical information on electric lamp holders.
Programme coordinators	Programme implementation information and challenges
Energy Commission	CFL Stock receipts (import), supply and distribution

4.0 FINDINGS

The findings of this report are based on: CFLs stock and allocation records; actual replacement of incandescent bulbs with CFLs in households; interviews with key stakeholders, recipient households and members of the project implementation team; electricity supply data on peak load; electricity demand and consumption data.

4.1 CFLs Stock and Allocation

A total of six million (6,000,000) CFLs were imported into the country by government, for distribution to households free of charge.

Specifications of the imported CFLs included: T5s (28 watts) and CFLs (20 watts-globe type), CFLs 20, 15, 11, 9, 7 and 5 watts.

During the replacement exercise a number of households received screw bulbs which did not match with their fitted pin type lamp holders. The impression created by these households was that more screw bulbs were imported as compared to pin type bulbs. This claim is false. The graph below depicts the percentage of screw to pin type bulbs imported.

Chart 1: Screw and Pin Type Bulbs imported

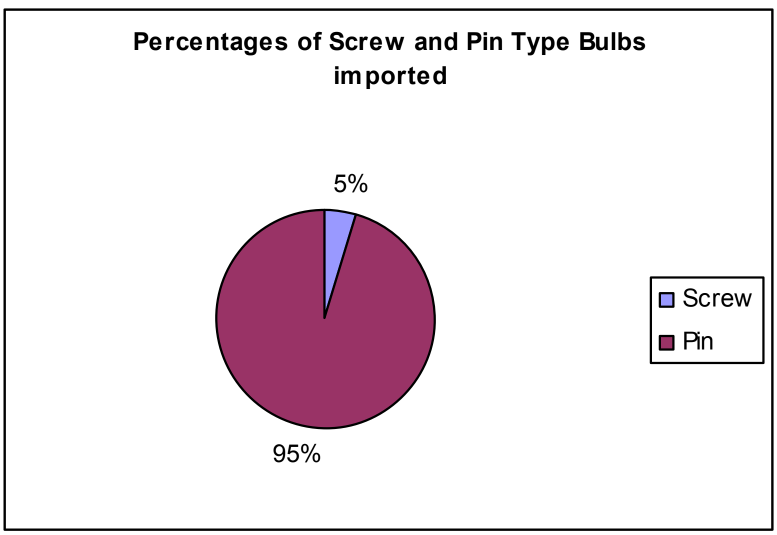
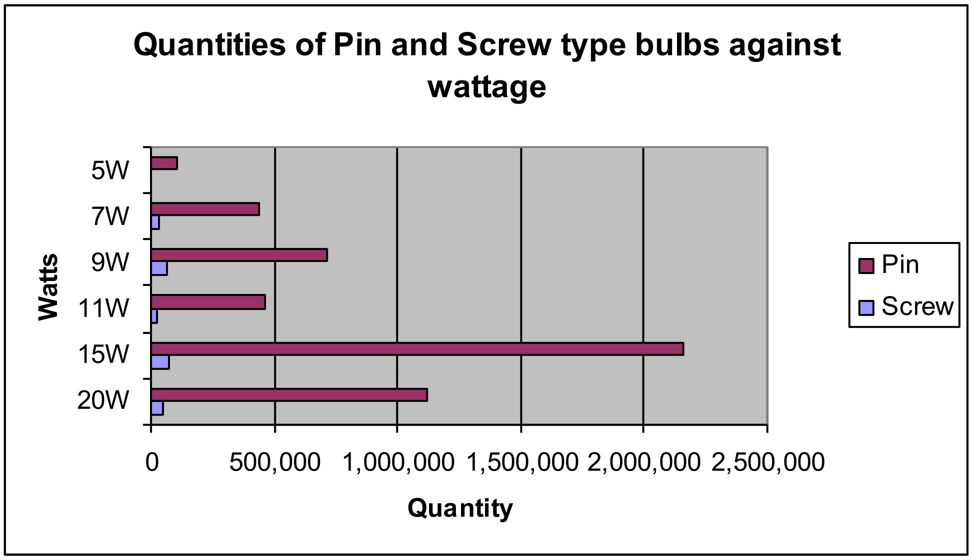


Chart 1 above reveals that 95% of the bulbs imported were pin type bulbs as against 5% which were screw type bulbs. Further examination of the proportions of the different wattages of bulbs allocated reveals a higher proportion of 20, 15 and 9watts bulbs. This is shown in the graph below.

Graph 1: Wattage of imported Bulbs



Source: Energy Commission

It is possible that a higher allocation of 11, 7 and 5 watts of the pin type bulbs and a greater proportion of the screw bulbs were allocated to the districts. The project team also confirmed that it was after the distribution that they realized that the labels B22 and E27 referred to the pin and screw type bulbs respectively. This means, the casual labourers and some members of the project team could not differentiate between the Pin and Screw bulbs when the allocations were being loaded onto the trucks at the central warehouse for distribution.

4.2 CFLs Distribution by Region/District

The six million CFLs imported were stored in a warehouse where stock allocations were carried out under the supervision of the Energy Commission. Distribution nationwide was carried out by a National Coordinator with the assistance of three Zonal coordinators. The installation was however carried out by distribution gangs in the various metros, municipals and districts nationwide. The verification of the CFLs distribution by district was done by assessing the coverage of the programme. The distribution covered all the 138 districts of the country except Bunkprugu-Yunyoo which had not been connected to the national grid and therefore had no grid electricity.

The figure below (fig1) shows in a snapshot the CFLs distribution by districts.

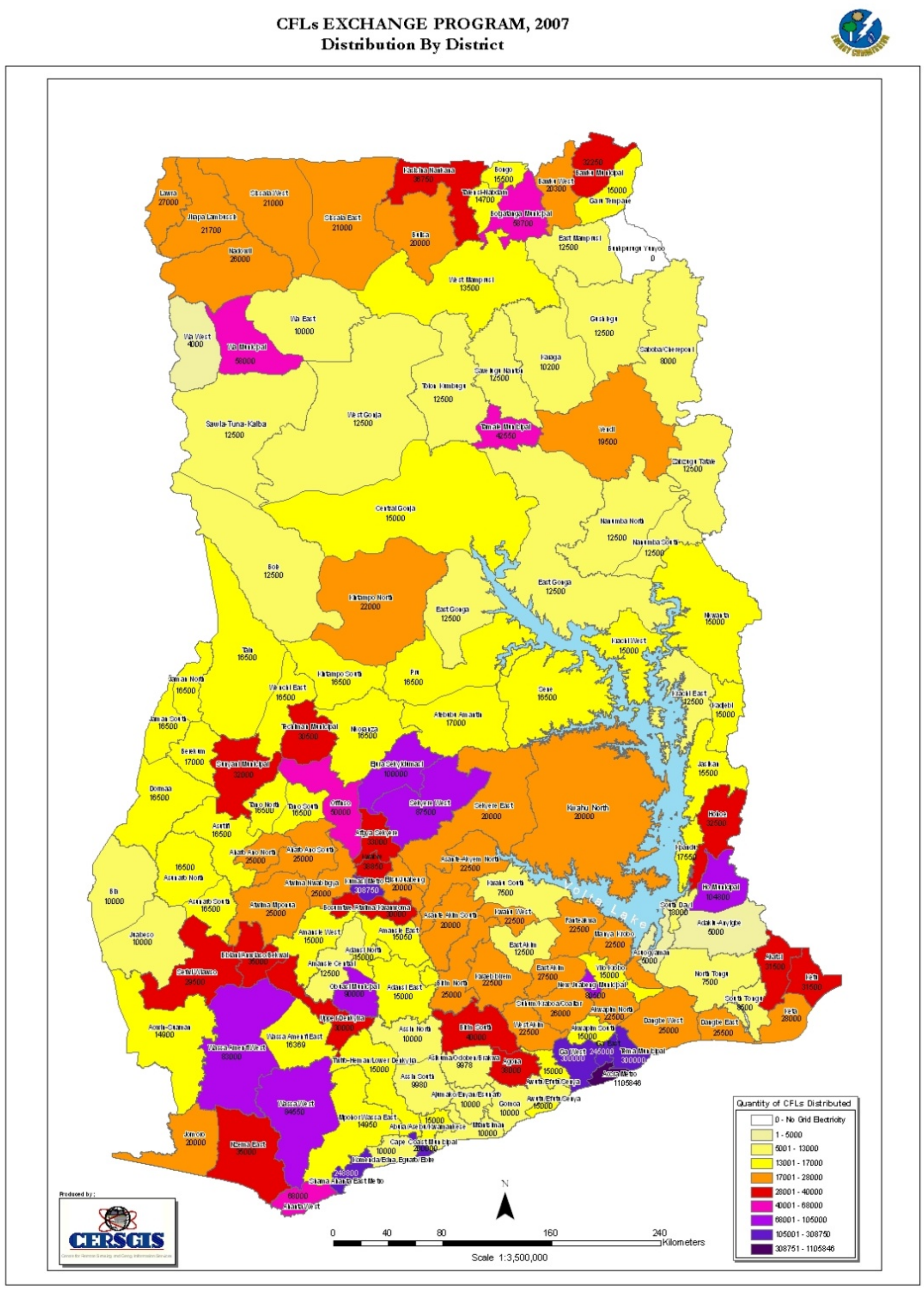


Figure 1: CFLs Distribution by Districts

The darker colours in the legend represent districts which received larger allocations of the CFLs whereas the lighter colours represent districts which received relatively small allocations. The white represents the Bunkpurugu Yunyoo district which has no grid-electricity and therefore not given any allocation of CFLs.

It was observed that Metropolis and Municipalities such as Accra, Tema, Kumasi, Obuasi, Tamale and Yendi received larger allocations than the districts. This connotes a fair distribution of the CFLs by density of households nationwide.

A detailed spreadsheet indicating the actual stock values of the CFLs distributed is attached as appendix 6.

4.3 Social Issues

Some of the observations made were; acceptability of the CFLs and political connotations

4.3.1 Acceptability

In all metropolis, municipalities and districts visited, it was observed that about 90% of the households that benefitted from the CFLs were satisfied with the performance of the bulbs in terms of the brightness, colour of light and low heat emission. Households visited expressed their readiness to have more of their incandescent bulbs replaced with CFLs. However most of the households expressed concern that they were not trained as to how to replace the bulbs themselves. Some also expressed concern as to where and how to get replacement for the bulbs in the future.

4.3.2 Socio-political observations

In the strongholds of the opposition political parties some households felt that the allocations were made in favour of supporters of the ruling party and therefore were neglected.

In extreme cases some households rejected replacement of CFLs because they felt it was a ploy to influence them to vote for the ruling party. (Refer to appendix 1 for a case of Cape coast municipality)

In some other cases, government functionaries who owe allegiance to the ruling party were alleged to have influenced the allocation, distribution and replacement of the CFLs.

4.4 Environmental Issues

Major observations made with regards to the environment were mercury emissions and disposal of CFLs.

4.4.1 Mercury Emissions

CFLs contain a very small amount of mercury (an average of 4mg) about the amount that will cover the tip of a ballpoint pen. By comparison, older thermometers contain about 500mg of mercury an amount equal to the mercury in 125 CFLs. Since mercury is harmful with direct contact it is required that CFLs users follow a thorough clean up and disposal guidelines whenever a CFL bulb gets broken.

An interview with the Environmental Protection Agency (EPA) disclosed that although the Agency is aware of the mercury pollutant in CFLs, measures are yet to be put in place to handle the disposal problems associated with CFLs.

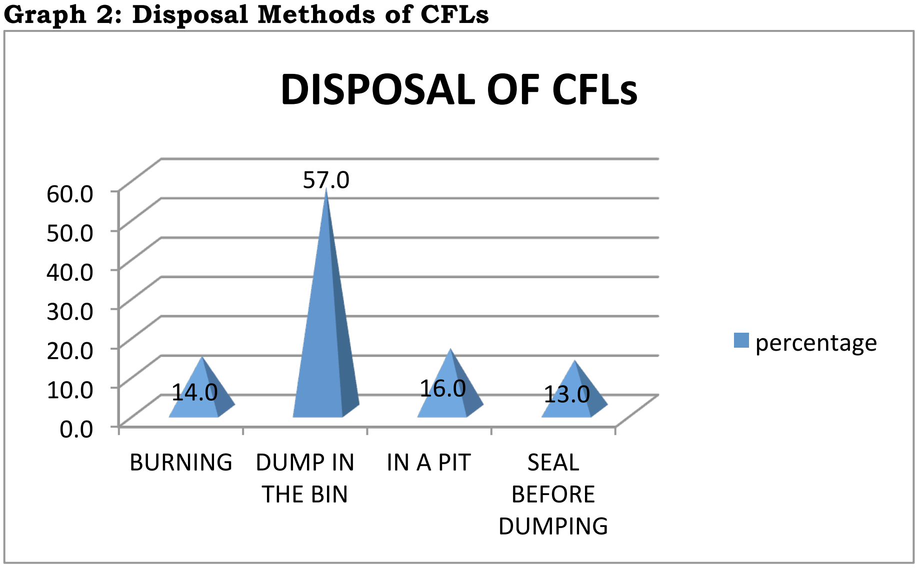
The EPA also expressed concern on large quantities of incandescent bulbs (inserted in fig 2 below) in many of the district assemblies such as West Mamprusi, Dangme East, Ajumako-

Enyan-Essiam, Asikuma-Odoben-Brakwa and Accra Metropolis which needs to be properly disposed off.

Figure 2: Incandescent bulbs at Accra Metropolitan Assembly

In addition to the concerns expressed by the EPA, the household survey also revealed that 57% of households interviewed disposed spoilt CFLs in the bin together with other household garbage. Whilst 16% and 14% of the households dispose spoilt CFLs in a pit or by burning respectively. This is shown in graph 2 below.

Graph 2: Disposal Methods of CFLs



It is noted therefore that as a general practice, households dispose off CFLs in a manner that does not conform to the accepted environmental practice. The waste management unit of the Accra Metropolitan Authority for instance confirmed the stated practice and affirmed that this could contaminate groundwater and soil.

4.5 Savings

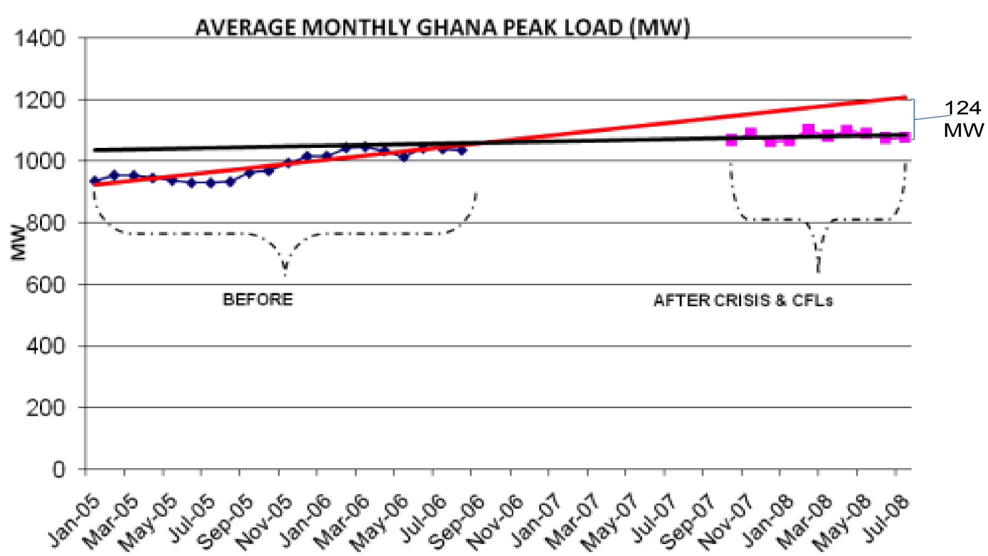
Major findings revealed savings on peak electricity, CO_2 and household income among others:

4.5.1 Electricity Peak Load Savings

It is established that the CFLs policy intervention in August 2007, which came with the introduction of 6million CFLs to replace incandescent bulbs for households resulted in electricity peak savings of 124MW. Information establishing the peak savings derived from the average monthly peak load is presented in graph 3 below.

Graph 3: Average Monthly Ghana Peak (Jan 05 - Jul 08)

Effect of CFL on National Electricity Demand



Source of data: VRA

Graph 3 above illustrates two scenarios: the period before the energy crisis, January 2005 to August 2006 and the period after the crisis with CFLs intervention, October 2007 to July 2008. Both scenarios presents average monthly peak load data in MW. The period in between both scenarios i.e. September 2006 to September 2007 represents the crisis period with its associated load shedding.

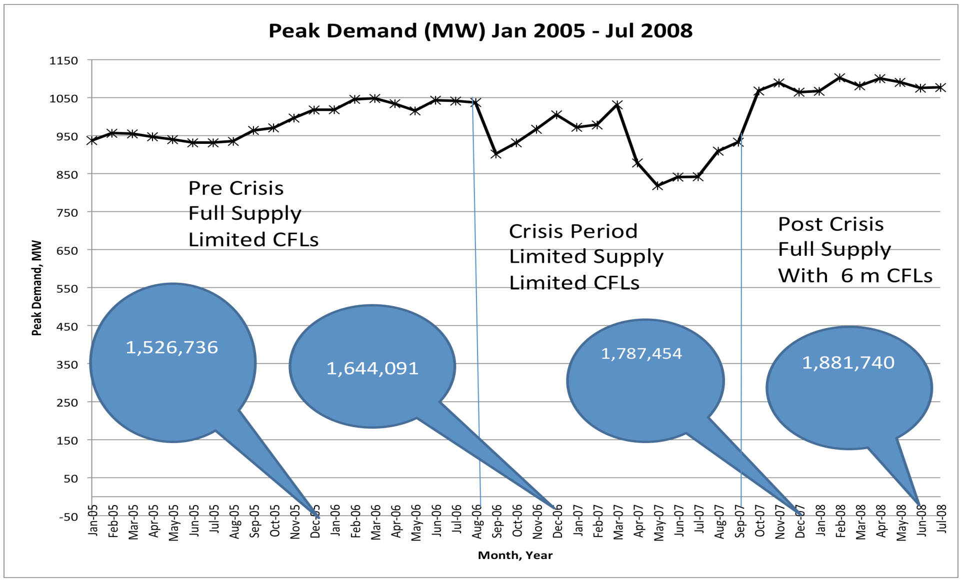
The first scenario shows a projection of the peak load before the energy crisis. This assumes the business as usual position where the peak load would have been 1200 MW by July 2008.

The second scenario shows the actual peak loads recorded after the crisis and with the CFLs policy intervention. This reveals a lower peak load of 1076MW as of July 2008.

A comparison of the first and second scenarios reveal a peak load savings of 124MW. This savings is attributed to the CFLs policy intervention since this was the only major energy policy intervention during the energy crisis.

Further observation also of the peak demand from January 2005 to July 2008 reveals an increase in electricity customer population from 1.5 to 1.9million. Inspite of this increase in electricity customer population, a reduction in peak load was revealed. This is illustrated in the portion marked ‘crisis period’ in graph 4 below.

Graph 4: Peak Demand (MW) (Jan 2005 - Jul 2008)



Source of data: VRA

It is disclosed in Graph 4 above that the peak demand for the pre-crisis period at a time of uninterrupted electricity supply and limited CFLs increased from 950 to 1050MW. The same period showed a growing customer population from 1.5 to 1.6 million. The increase in peak demand registered during the pre-crisis period however stabilized in the post-crisis period. The period also showed an increase in customer population to about 1.9 million.

The monetary value of the 124 MW peak savings is US$ 3.6 million. This is calculated and shown in appendix 2.

4.5.2 CO_2 Savings

The CO_2 savings from the resultant peak savings of 124MW is also calculated and expressed in monetary terms as US$ 1,179,360. This calculation is shown in appendix 3.

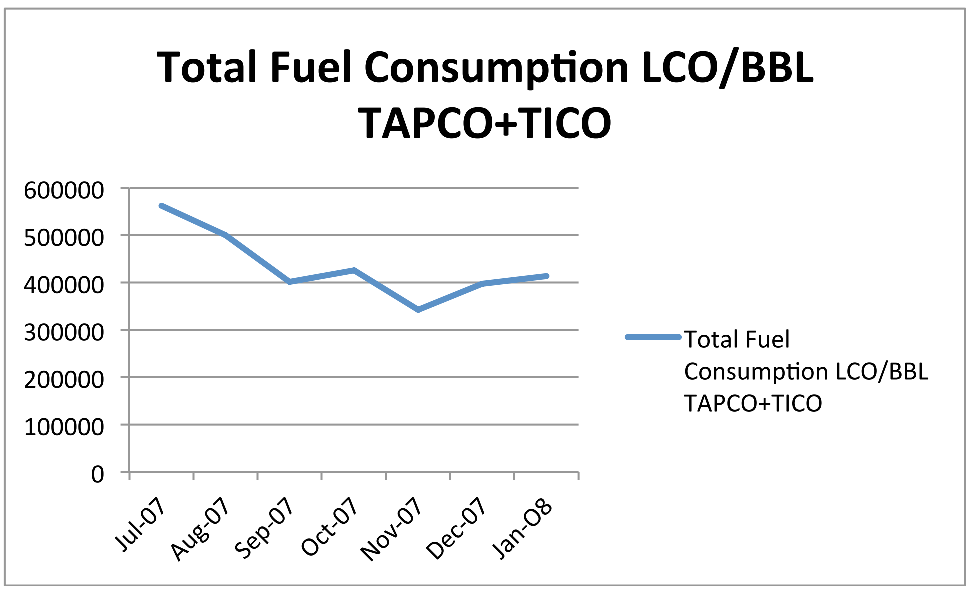
4.5.3 Delayed Investment in Power Generation Expansion

As a result of the peak savings of 124MW, a delay in investment in expansion generation occurred. Given the cost of generating 1kW of thermal electricity at peak periods from TICO to be US$ 850/kW the peak savings of 124 MW resulted in a delay in investment of about US$ 105 million. This is illustrated in appendix 4.

4.5.4 Reduction in Light Crude Oil (LCO-bbl) consumption for Thermal Generation

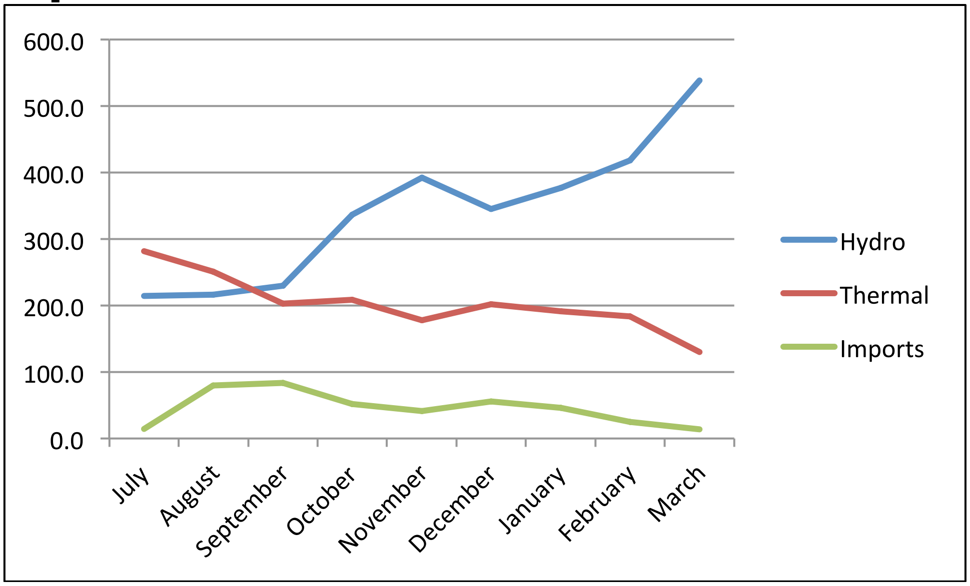
A reduction of 148, 000 barrels in Light Crude Oil consumption for thermal generation in respect of the TICO and TAPCO plant was recorded from July 07 to January 08. This is shown in graph 5 below.

Graph 5: Total Fuel Consumption (LCO-bbl)



Generation of power from the TAPCO and TICO plants as well as electricity imports also reduced. This is observed in graph 6 below.

Graph 6: Power Generation in GWh

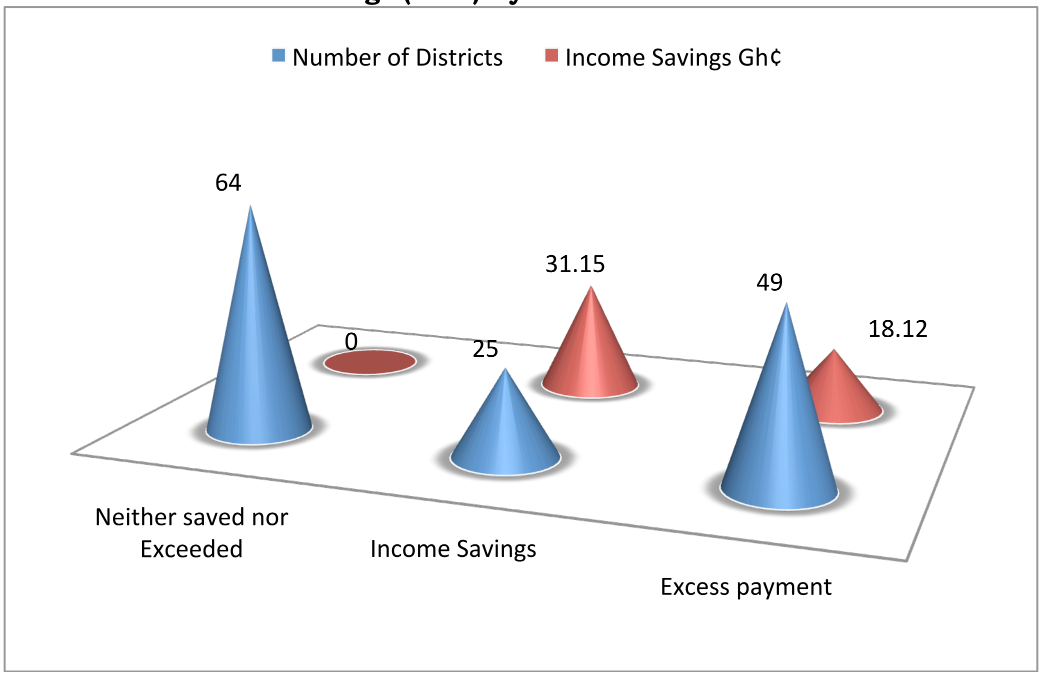


4.5.5 Income savings

It is revealed in chart 2 below that 25 districts recorded a mean electricity savings of 270 kWh which translates to GH¢31.00 for the period January to June 2008.

In addition, 64 districts remained on the same level of their electricity consumption whilst only 49 districts exceeded their electricity consumption by 151 kWh for the same period. This resulted in an additional payment of about GH¢18.00 per household. This is shown in appendix 5.

Chart 2: Net income savings (GH¢) By Districts



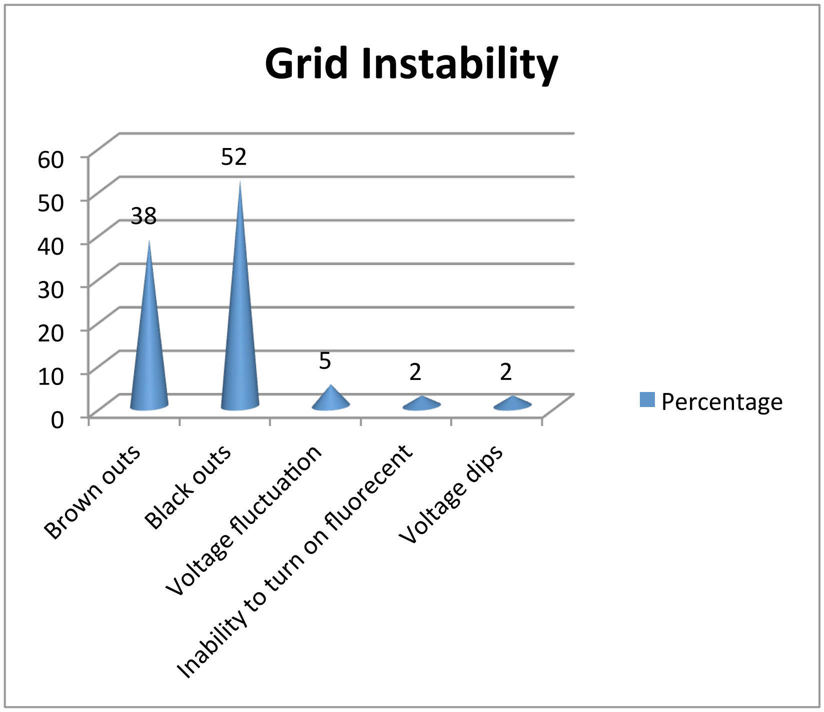
4.6 Technical Issues

The two main technical issues are the stability of the electricity system and suitability of lamp holders.

4.6.1 Stability of Electricity System

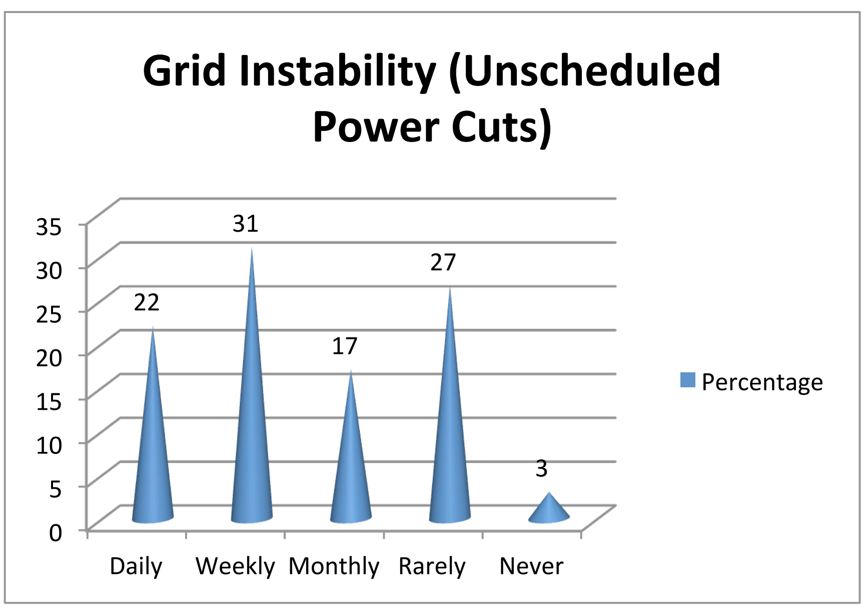
Two issues were investigated: scheduled and unscheduled power cuts. Blackouts in this respect refers to scheduled power cuts. Interviews on brownouts and blackouts revealed the following: 52% of households admitted that they experience blackouts whilst 38% said they experience brownouts. This is illustrated in Graph 8 below

Graph 7: Brownouts and Blackouts



Further investigation on unscheduled power cuts also revealed that 31% of households experience unscheduled power cuts weekly whilst 22% experience power cuts daily. This is shown in graph 9 below.

Graph 8: Unscheduled Power Cuts



Following the investigations on blackouts and unscheduled power cuts, households confirmed from the presentations above that, the objective of grid stability was not attained. Unfortunately information relating to transformer overloads was not provided by the electricity distribution utilities.

4.6.2 Lamp Holders

The Ghana Association of Electrical Contractors expressed concern on the suitability of lamp holders for CFLs. It claimed that the screw-type lamp holders are most suitable because the bulbs fit very well on them. However the pin type-lamp holders are the most common and widely used in Ghana. The association indicated that there are problems with the pin type lamp holders and these include; faulty pins, melting of the lead due to heat and loose springs in the terminals.

According to the association there are about 80% of the pin type lamp holders on the market which are substandard. An exercise to phase out these lamp holders with the Ghana Standards Board is on course.

4.7 Implementation Bottleneck

A few bottlenecks were identified by stakeholders such as ECG, Ghana Association of Electrical Contractors, AGI, NED and PURC.

Generally, they complained of their non-involvement in the planning and implementation of the programme.

Specific complaints were;

- The inability of the implementation team to conduct a baseline study for effective comparison.
- Inadequate training for personnel that constituted the distribution gang.
- Inadequate awareness creation on the objectives of the CFLs programme.

5.0 CONCLUSION

The CFLs exchange programme achieved its main objective for the reduction of peak electricity supply through the injection of six million CFLs. The assessment revealed peak electricity savings of 124MW, expressed in monetary terms as US$ 3.6million per month.

In addition to peak electricity savings, a CO_2 savings of 112,320 tons/day (about US$ 1,179 360) was established. Considering the delay in investment in power plants, the country saved about US$ 105,000. In terms of reduction in Light Crude Oil consumption for thermal power generation, a reduction of 148,000 barrels of light crude oil was realized.

Other socioeconomic benefits associated with the CFLs exchange programme were; 90% acceptability of the CFLs technology, better illumination of indoor and outdoor surroundings and mean income savings of GH¢31.00 for 25 out of 138 districts as of 2007.

There were however a few setbacks with the implementation of the CFLs exchange programme. These included: lack of co-operation of some major stakeholders in the planning and implementation of the exercise, the oversight of environmental issues in the disposal and handling of the broken CFLs, inadequate training and awareness creation for personnel of the distribution gang and household beneficiaries.

6.0 RECOMMENDATIONS

As a result of the savings and social benefits derived from the CFLs intervention, it is recommended that the programme should be expanded to reduce the peak electricity supply and delay investments in thermal electricity generation.

The implementation of the expanded programme should consider the following: involvement of major stakeholders and institutions in planning, coordination and implementation, training of personnel for implementation and awareness creation on avoidance of mercury contamination for beneficiary households especially women and children.

In view of the significant CO_2 savings realized, opportunities should be explored for the consideration of the CFLs programme as a major Clean Development Mechanism (CDM) project.

As a result of variability of data sources and methods of estimating savings (electricity, CO_2 and income), a stakeholder expert group should be constituted to review this report.

APPENDICES

Appendix 1: Politicization - A case of Cape - Coast Municipality.

Politicization by some members of the Public – Some members of the general public, read political meanings into the exercise and tried to frustrate the process. Some of the utterances by die-hard fans of some opposition political activists were so absurd and infantile that, it makes one wonder the kind of electorates we have in this country. For example, during a phone-in programme on one of the radio stations to create awareness with the coordinator, a caller remarked "since his bulbs were changed into the CFLs, anytime he slept; he saw an elephant in his dreams. The interpretations for his so-called dreams were that, President Kuffuor had gone in for 'juju' hence the distribution of the bulbs. He claimed that, the bulbs were meant to change the minds of Ghanaians to vote for the NPP in the next elections". However, persistent education curtailed such behaviour and people came to appreciate the exercise. However, the publicity and frequent education through radio programmes by the Coordinator, which included phone-in programmess on the rationale for the exercise, toned down the politicization

Appendix 2: Calculation of monetary value for 124MW peak savings for the month June 2008

Given:

TICO thermal electricity supply tariff to be =

US $ 0.2427/kWh

Peak savings/day = 124MW = 124,000 kW

Peak period hrs/day = 4

Peak savings = peak savings/day *peak hrs* US$/kWh

124 000*4hrs*0.2427= US$ 120, 379.20 per day

124 000*4*0.2427* 30 = US$ 3,611, 376. 00 per month

Appendix 3: Calculation of monetary value for CO2 savings

Cost of CO_2 US$/ton = 10.5

Emission factor of Carbon = 0.65 kg /kWh

kWh saved per day = 480,000 kWh

CO_2 savings per day = 480* 0.65 = 312 tons

CO_2 savings per annum =112, 320 tons

CO2 savings in US$ per annum = 112, 320 * 10.5

= US$ 1,179,360 p.a.

Appendix 4: Calculation of investment cost for savings

Peak savings = 124 MW

Investment cost = US $ 850/kW: This excludes variable cost, fixed and fuel cost.

Investment Cost for 124MW peak savings

= investment cost/kW *peak savings (kW)

124MW =124*1000kW =124,000kW

= 124,000kW*850US$/kW = US$105,400,000.00 per kW = US$105,400.00 per MW

Appendix 5: Calculation of income savings

Using the current approved tariff rate of (GH¢0.095)/kWh for consumer class (0-50kWh) and (GH¢0.12)/kWh, for consumer class (51-300kWh),

(50 *0.095) + (220* 0.12) **=** GH¢31.12 per consumer.

Appendix 6: Distribution of CFLs Nationwide

Region	District	Qty Received	Regional Total
ASHANTI	Adansi North	15,000	
ASHANTI	Adansi South	15,000	
ASHANTI	Afigya-Sekyere	11,000	
ASHANTI	Ahafo Ano North	25,000	
ASHANTI	Ahafo Ano South	25,000	
ASHANTI	Amansie Central	12,500	
ASHANTI	Amansie East	15,000	
ASHANTI	Amansie West	15,000	
ASHANTI	Asante Akim North	54,950	
ASHANTI	Asante Akim South	20,000	
ASHANTI	Atwima Mponua	25,000	
ASHANTI	Atwima Nwabiagya	25,000	
ASHANTI	Bosomtwe/Atwima/ Kwanwoma	30,000	
ASHANTI	Ejiso-Juabeng	20,000	
ASHANTI	Ejura/Sekyeredumasi	84,650	
ASHANTI	Kumasi Metro	360,000	
ASHANTI	Kwabre	16,500	
ASHANTI	Obuasi	90,000	
ASHANTI	Offinso	50,000	
ASHANTI	Sekyere East	20,000	
ASHANTI	Sekyere West	87,500	**1,017,100**
BRONG AHAFO	Asunafo North	16,500	
BRONG AHAFO	Asunafo South	16,500	
BRONG AHAFO	Asutifi	16,500	
BRONG AHAFO	Atebubu/Amantin	17,000	
BRONG AHAFO	Berekum	17,000	
BRONG AHAFO	Dormaa	16,500	
BRONG AHAFO	Jaman North	17,000	

BRONG AHAFO	Jaman South	16,500	
BRONG AHAFO	Kintampo North	22,000	
BRONG AHAFO	Kintampo South	16,500	
BRONG AHAFO	Nkoranza	37,800	
BRONG AHAFO	Pru	16,500	
BRONG AHAFO	Sene	16,500	
BRONG AHAFO	Sunyani Municipal	32,000	
BRONG AHAFO	Tain	16,500	
BRONG AHAFO	Tano North	16,500	
BRONG AHAFO	Tano South	16,500	
BRONG AHAFO	Techiman Municipal	30,500	
BRONG AHAFO	Wenchi	16,500	**371,300**
CENTRAL	Abura/Asebu/Kwamankese	15,000	
CENTRAL	Agona	50,000	
CENTRAL	Ajumako Enyan Essiam	10,000	
CENTRAL	Asikuma/Odoben/Brakwa	10,000	
CENTRAL	Assin North	10,000	
CENTRAL	Assin South	10,000	
CENTRAL	Awutu Effutu Senya	20,000	
CENTRAL	Cape Coast Municipal	200,000	
CENTRAL	Komenda Edina Eguafo Abrem	10,000	
CENTRAL	Mfantsiman	10,000	
CENTRAL	Twifo Hemang Lower Denkyira	15,000	
CENTRAL	Upper Denkyira	30,000	
CENTRAL	Gomoa	10,000	**400,000**
EASTERN	Afram Plains	20,000	
EASTERN	Asuogyaman	12,000	
EASTERN	Akuapim North	22,500	
EASTERN	Akuapim South	15,000	
EASTERN	Atiwa	12,500	

EASTERN	Birim North	25,000	
EASTERN	Birim South	40,000	
EASTERN	East Akim	27,500	
EASTERN	Fanteakwa	22,500	
EASTERN	Kwaebibirem	22,500	
EASTERN	Kwahu South	7,000	
EASTERN	Kwahu West	22,500	
EASTERN	Manya Krobo	22,500	
EASTERN	New-Juaben	68,000	
EASTERN	Suhum/Kraboa/Coaltar	26,000	
EASTERN	West Akim	22,500	
EASTERN	Yilo Krobo	15,000	**403,000**
GREATER ACCRA	Accra Metro	1,127,930	
GREATER ACCRA	Dangbe East	30,000	
GREATER ACCRA	Dangbe West	25,000	
GREATER ACCRA	Ga East	233,000	
GREATER ACCRA	Ga West	300,000	
GREATER ACCRA	Tema Municipal	300,000	**2,015,930**
NORTHERN	Bole	12,500	
NORTHERN	Bungprugu-Yunyoo	0	
NORTHERN	Central Gonja	15,000	
NORTHERN	East Gonja	12,500	
NORTHERN	East Mamprusi	12,500	
NORTHERN	Gushiegu	12,500	
NORTHERN	Karaga	10,200	
NORTHERN	Nanumba North	12,500	
NORTHERN	Nanumba South	12,500	
NORTHERN	Saboba Chereponi	12,500	
NORTHERN	Savelugu-Nanton	12,500	
NORTHERN	Sawla-Tuna-Kalba	12,500	

NORTHERN	West Gonja	12,500	
NORTHERN	West Mamprusi	13,500	
NORTHERN	Tamale Municipal	52,800	
NORTHERN	Zabzugu Tatale	12,500	
NORTHERN	Tolon Kumbugu	12,500	
NORTHERN	Yendi	19,500	**261,000**
UPPER EAST	Bawku Municipal	33,200	
UPPER EAST	Bawku West	21,400	
UPPER EAST	Bolgatanga Municipal	58,700	
UPPER EAST	Bongo	16,000	
UPPER EAST	Builsa	20,000	
UPPER EAST	Garu-Timpane	21,150	
UPPER EAST	Kassena-Nankana	36,750	
UPPER EAST	Talensi Nabdam	14,700	**221,900**
UPPER WEST	Jirapa/Lambusie	21,700	
UPPER WEST	Lawra	27,000	
UPPER WEST	Nadowli	26,000	
UPPER WEST	Sissala East	21,000	
UPPER WEST	Sissala West	21,000	
UPPER WEST	Wa East	10,000	
UPPER WEST	Wa Municipal	48,000	
UPPER WEST	Wa West	4,000	**178,700**
VOLTA	Adanklu Anyibge	5,000	
VOLTA	Akatsi	30,000	
VOLTA	Ho Municipal	104,800	
VOLTA	Hohoe	32,500	
VOLTA	Jasikan	15,500	
VOLTA	Kadjebi	15,000	
VOLTA	Keta	28,000	
VOLTA	Ketu	31,500	

VOLTA	Kpando	17,550	
VOLTA	Krachi East	12,500	
VOLTA	Krachi West	15,000	
VOLTA	Nkwanta	15,000	
VOLTA	North Tongu	7,500	
VOLTA	South Dayi	13,000	
VOLTA	South Tongu	8,500	**351,350**
WESTERN	Ahanta West	70,000	
WESTERN	Aowin Suaman	15,000	
WESTERN	Bia	10,000	
WESTERN	Bibiani Anhwiaso	35,000	
WESTERN	Jomoro	20,000	
WESTERN	Juaboso	10,000	
WESTERN	Mpohor Wassa West	15,000	
WESTERN	Nzema East	35,000	
WESTERN	Sefwi Wiawso	20,000	
WESTERN	Shama Ahanta East Metro	217,000	
WESTERN	Wassa Amenfi East	23,000	
WESTERN	Wassa Amenfi West	30,000	
WESTERN	Wassa West	100,000	**600,00**
	TOTAL DISTRICT DISTRIBUTION	**5,820,280**	
	TOTAL DISTRIBUTION MDAs + EDUCATIONAL INSTITUTIONS	**310,820**	
	TOTAL IMPORT	**6,131,100**	