Malawi: Development of a Large-Scale Energy Efficient Lighting Program

CFL Program Design and Implementation Plan

Final Report

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Contents

Acronyms

APCF	-	*Asia Pacific Carbon Fund*
CAMA	-	*Consumer Association of Malawi*
CDM	-	*Clean Development Mechanism*
CFL	-	*Compact Fluorescent Lamp*
CLASP	-	*Collaborative Labeling and Appliance Standards Program*
DFID	-	*Department for International Development*
DEA	-	*Department of Environmental Affairs*
DoEA	-	*Department of Energy Affairs*
DPP	-	*Office of the Director of Public Procurement*
DSM	-	*Demand Side Management*
EA	-	*Executing Agency*
ECF	-	*Energy Conservation Fund*
EE	-	*Energy Efficiency*
EELP	-	*Energy Efficient Lighting program*
ELI	-	*Efficient Lighting Initiative*
ESCOM	-	*Electricity Supply Corporation of Malawi Ltd*
FCF	-	*Future Carbon Fund*
FTL	-	*Florescent Tube Lighting*
GWh	-	*Giga watt hour*
GOM	-	*Government of Malawi*
IA	-	*Implementing Agency*
ICB	-	*international competitive bidding*
IB	-	*Incandescent Bulb*
LWM	-	*Lighting Waste Management*
M&E	-	*Monitoring & Evaluation*
MBS	-	*Malawi Bureau of Standards*
MCA-M	-	*Millennium Challenge Account - Malawi*
MERA	-	*Malawi Energy Regulatory Authority*
Mg	-	*milligram*
MEPS	-	*Minimum energy performance stasndards*
MK	-	*Malawi Kwatcha*
MNREE	-	*Ministry of Natural Resources Environment and Energy*
MoF	-	*Ministry of Finance*
MoIT	-	*Ministry of Industry and Trade*
MRA	-	*Malawi Revenue Authority*
MW	-	*Megawatt*
NTT	-	*Net to total*

ppm	-	*parts per million*
pt	-	*participation test*
PSC	-	*Project Steering Committee*
RoHS	-	*Restriction on Hazardous Substances*
SAPP	-	*Southern African Power Pool*
SBD	-	*Standard Bidding Documents*
SHW	-	*Solar Hot Water*
T&D	-	*Transmission and Distribution*
TWG	-	*Technical Working Group*
TOU	-	*Time of Use*
UCT	-	*Utility cost test*
W	-	*Watts*
WB	-	*World Bank*

EXECUTIVE SUMMARY

BACKGROUND

The Government of Malawi (GoM) is proposing to implement a large-scale Energy Efficient Lighting Program (EELP) with the aim of reducing the evening system peak demand. The implementation of the program will be coordinated through the Ministry of Natural Resources, Energy and Environment (MNREE), the Electricity Supply Corporation of Malawi (ESCOM) and the Malawi Energy Regulatory Authority (MERA). The project is supported by the Department for International Development (DFID) through the Growth and Resilience Team in Malawi.

This Report covers the Design for the CFL Program and Implementation Plan

PROGRAM RATIONALE

The supply and demand scenarios in the Malawi Electricity Sector show a trend of significant capacity shortage in the foreseeable future, due to an increase in demand averaging 7% per year. Currently the system average peak load is around 295 MW, while the available capacity is around 255 MW which equates to a power shortage of 14%. In addition, there are around 13,000 customers waiting to be connected and ESCOM estimates the total demand to be around 334 MW. Load shedding and power outages are used extensively to ration power.

ESCOM has implemented a Time of Use (TOU) tariff which partly addresses the power shortage during the morning peak. The proposed CFL program is designed to reduce the evening system peak demand and the magnitude of the impact will be dependent on the current penetration of Incandescent Bulbs (IBs) which will be replaced with CFLs.

PROGRAM SUSTAINABILITY

International programs have shown that the distribution of 1 Million CFLs will reduce ESCOM's system peak demand by an average of 30MW. Hence, a large scale CFL program aimed at replacing the bulk of the IBs would offer ESCOM a viable option of addressing the current imbalance of supply and demand. On the supply side, the average cost of capacity (for a hydro power plant) is around $2,500 per MW which translates to $75 Million for a 30 MW plant with a design and construction period of 5 to 7 years. On the demand side, 1 Million CFL program would cost around $1.5 Million and saving 30MW with an implementation period of less than one year.

The program design is based on the replacement of a maximum of 6 IBs that are currently installed in households with CFLs and is expected to have a direct impact on reducing the evening peak demand as the time of use of the CFLs is coincident with the peak period.

To derive the demand savings the program implementation procedures need to ensure that the existing IBs are immediately replaced by the CFLs provided under the program. Experience in other countries has shown that direct installation to be the most effective way.

The demand for efficient lighting, particularly in the residential sector, is expected to increase significantly in the foreseeable future due to increased electrification (currently only at 7%). Low quality CFLs currently dominates the market due to affordability and the lack of consumer awareness of the life cycle benefits of good quality long life CFLs. The program aims to transform the existing CFL market from low quality CFLs to affordable high quality CFLs that would benefit the customer, ESCOM and society as a whole. Policy interventions are proposed for the

introduction of minimum energy performance standards (MEPS) in order to ensure sustainability. Enforcement of MEPS will enhance the quality of lamps in the market. Also, affordability is likely to be a less of an issue as the unit costs of CFL are reducing and retailers would sell at lower margins in a competitive environment.

The program includes the distribution of CFLs through selected electrical retailers to ensure participation of the private sector, who would ultimately be the key to the promotion of energy efficient lighting. The proposed establishment of a Revolving Fund supported by the proceeds of the sale of CFLs to the private consumers would also play a role in not only market transformation of IBs to CFLs but also support other Demand-side Management (DSM) programs that would help ESCOM in managing the future demand.

The proposed program incorporates a Consumer Awareness and Promotion Campaign. The campaign will be designed based on existing customer perceptions and also focusing on the benefits of using efficient lighting in the long term.

A summary of the proposed program design, budget and expected impacts are given below.

SUMMARY OF PROPOSED PROGRAM DESIGN

The key features of the proposed program are given in the Table below:

Parameter	*Description*	*Comments*
No: of CFLs	2.0 Million	Estimates provided by ESCOM
CFL Wattage	15W (75%) and 20W (25%)	Based on the estimated market share of IB wattage and type of fitting
CFL life / warranty	10,000 hours / 2-year warranty	Normally the warranty would apply from the date of delivery
Eligibility	All ESCOM customers	
CFLs per customer	Residential and Small Enterprises – Maximum of 6 existing IBs will be replaced with CFLs Public Sector – all existing IBs will be replaced with CFLs Private Sector – Provision of purchasing CFLs at discounted price from ESCOM Centers and participating retailers	Need to exchange equivalent no. of working IBs. Limit IB wattages to 40W-100W The number of CFLs per customer could be flexible depending on the participation rates
Technical Specifications	Revised ELI specifications used by SAPP for other CFL programs.	Revised for 10,000 hour lamp life and 2 year warranty
Distribution	Direct installation by ESCOM sub-contractors – the existing IBs are replaced by CFLs. Also distributed via ESCOM Centers and Retailers	Need to ensure enough resources to complete the installation within 3 months.
Program costs	CFLs are provided free-of-charge for residential, small enterprise and public buildings.	The revenue generated from the sale of CFLs will be deposited in a REVOLVING FUND to be

Parameter	*Description*	*Comments*
	CFLs sold to the private sector is likely to be below the current price of a low quality CFLs (~ 300 MK)	maintained by Ministry of Finance.
Disposal of IBs	The IBs collected from the customer premises shall be disabled and the no. of IBs by wattage shall be recorded prior to safe disposal.	The feasible disposal option shall be determined for MNREE
Marketing and Promotion	A Consumer awareness program will be implemented in parallel with the CFL program	The program could be undertaken by ESCOM Marketing and Business Development Unit in conjunction with Consumer Welfare Association of Malawi
Program Duration	1 year	It is expected that the initial procurement, distribution, monitoring and evaluation period will not exceed one year

SUMMARY OF PROGRAM COSTS

A summary of the estimated program costs are:

Item	Description	Cost (US$)	Assumptions and Comments
Equipment	2 Million CFLs	2,450,000	Unit price $1.225 excluding VAT landed cost in Malawi
Program Costs	Administration	100,000	Cost of additional resources at ESCOM for program administration
	Distribution	150,000	Costs of sub-contractors for direct installation
	Lamp storage (CFL & IBs)	15,000	Storage costs of CFLs and exchanged IBs
	Lamp Disposal (IBs)	15,000	Safe disposal of IBs after verification
	Marketing & Promotion	100,000	marketing & promotion campaign
	Monitoring & Evaluation	50,000	Consultancy for M&E activities
Miscellaneous	TA for Implementation	70,000	Consultancy services for implementation support (if required)
	Contingency	50,000	
Total		3,000,000	

SUMMARY OF BENEFITS

The summary of benefits to ESCOM and Customers is given in Table below:

ESCOM System Impacts	
Energy Savings (GWh/yr)	*139*
Lifetime Energy Savings (GWh)	*1,270*
Demand Saving (MW)	*76.2*
ESCOM Benefit/Cost Ratio (Note 1)	*81.75*
Customer Impacts	
Payback Period (Months) – (Note 2)	*5.80*
Benefit/Cost Ratio	*18.91*

Note 1: Assumes revenues from the sale of CFLs to private consumers.

Note 2: Assumes the private consumers pay $2.00 (300 MK) for CFLs

It should be noted that the potential demand savings average 37 MW per 1 Million CFLs at the generation level when considering the current system losses of around 21%. The demand savings are computed based on the assumption that all CFLs provided under the program will be used as a replacement of existing IBs. However, in reality this may not be the case as the direct installation option is only enforced in the residential, small enterprises and public sector; which is estimated to account for 1.3 Million CFLs (based on 6 per customer). Hence, the initial demand reduction is expected to come from these sectors.

The private sector allocation of 700,000 CFLs is likely to be used for different purposes – replacement of existing IBs, replacement of existing low quality CFLs and for new light fittings. Hence, the expected demand reduction is likely to be less than computed and will be achieved only over a period of time.

PROPOSED NEXT STEPS

Following the acceptance of conceptual design and indicative budget for implementation, the following activities are proposed to finalize the design and implementation plan:

1. Baseline Consumer Survey – The survey would target the residential sector and include 3 segments (low, medium and high usage) to determine the current penetration of different lighting types, average usage, type of light fittings and customer perceptions of use of CFLs. The results of the survey will be used for refining the program design, formulating the key messages of the Consumer Awareness and promotion Program; and determining baselines for specific performance indicators.

2. Lighting Market Survey – A survey of major electrical retailers to be undertaken to determine the existing market share of various lighting technologies and barriers to the promotion of energy efficient lighting. The survey would also solicit interest in participation in the proposed CFL program, expectations and recommendations on implementation procedures.

3. Revolving Fund Design – Prepare procedures for the establishment of revolving fund, structure, operating guidelines, fund management and administration.

4. Project Management – Finalize project management and implementation structure. Define roles and responsibilities of the Steering Committee, ESCOM Project Management Unit and the TA Consultants. Preparation of EOI and contract templates for the engagement of installers and electrical retailers.

5. Consumer Marketing and Promotion – Define program marketing strategies and scope. Assess capacity of local firms to design and implement promotional campaigns. Assess overall costs for design, advertising and promotional activities. Prepare detailed Terms of reference (TOR) for this activity.

6. Monitoring and Evaluation – Finalize program evaluation indicators and establish baselines for performance monitoring. Prepare templates for monitoring and guidelines for evaluation. Prepare detailed TOR for the overall M&E function.

7. Technical Assistance (TA) for Implementation – Define the role and scope of TA; and determine selection procedures. In addition to overall implementation assistance to ESCOM the scope could include M&E functions and promotion activities.

8. Bid Documents – Finalization of the Bidding Documents for the CFLs and determine advertising channels for procurement.

9. Project Budget – Detailed evaluation and refinement of the project cost components and determine funding sources for each component.

1 INTRODUCTION

The Government of Malawi (GoM) is proposing to implement a large-scale Energy Efficient Lighting Program (EELP) with the aim of reducing the evening system peak demand. The implementation of the program will be coordinated through the Ministry of Natural Resources, Energy and Environment (MNREE), the Electricity Supply Corporation of Malawi (ESCOM) and the Malawi Energy Regulatory Authority (MERA). The project is supported by the Department for International Development (DFID) through the Growth and Resilience Team in Malawi.

This Report covers the design for the CFL Program and Implementation Plan

1.1 Project Objectives and Outcomes

The key objectives of the project are:

a) Design of a large scale Compact Fluorescent Lighting (CFL) Program targeting all consumer sectors with the aim of reducing the system evening peak demand;

b) Develop a implementation plan for the distribution of CFLs

c) Develop methodologies for the monitoring and evaluation of savings;

d) Develop terms of reference for a consumer awareness program; and

e) Prepare draft Bid Documents for the procurement of CFLs

f) Propose other Demand-side Management activities that could be considered in the future

The output of this assignment will enable the Government of Malawi (GOM) to finalise resources and commence the implementation of the CFL program.

2 ESCOM CHARACTERISTICS

2.1 Supply and Demand Characteristics

Generation Capacity

The installed capacity as of 2007 was 285 MW and the available capacity is around 255 MW. According to ESCOM forecasts, the peak demand in 2010 is 334 MW and total generation of 1,672 GWH. The generation capacity is expected to increase to 347 MW based on increased supply from Kapichira II and other rehabilitation works. ESCOM estimates an average demand increase of 5 MW per year in the residential sector alone due to increased electrification.

Demand Characteristics

With the introduction of Time-of-Use tariff, the current peak demand has been restricted to 334 MW. However, with the available capacity of around 255 MW the current capacity shortage is 31%. ESCOM load forecasts estimate a step load increase of 37 MW per year for the next 10 years. There are various supply side options that are being considered that would address this shortfall in the medium term.

The overall transmission and distribution losses are estimated to be currently 21% with around 14% being technical losses from aging power plants.

2.2 Customer Characteristics

Analysis of ESCOM Data

The data analysis show that nearly 175,000 (82%) of the customer base is from the residential sector, which would be the primary target of the CFL Program. ESCOM estimate an average of 17,000 new customers annually as a result of its electrification program and these would be predominantly in the residential sector. Details of the customer categories and number of connections are given in Table 2.1.

Residential customers account for around 44% of the electricity sales, while General customers account for 12% of the sales. The remaining electricity sales are in the commercial and industrial sectors (small and large), accounting for nearly 43% of the total sales.

Table 2.1: Breakdown of ESCOM's Customers in 2010

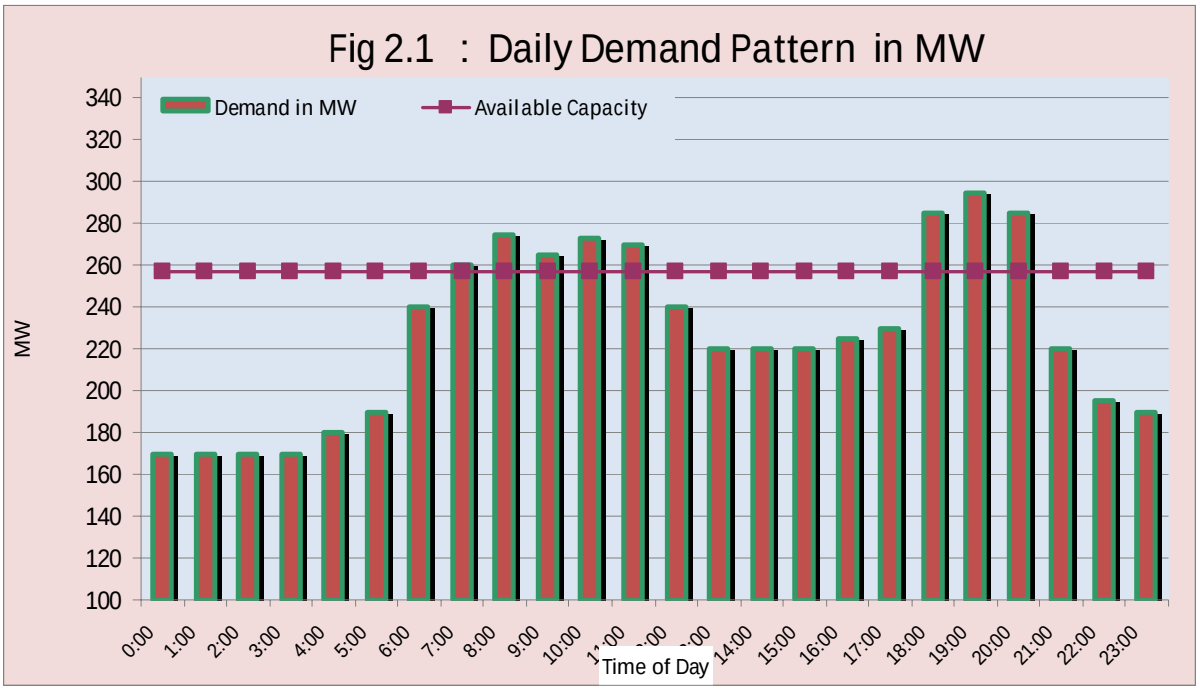
Customer	Type of Supply	No of Customer
Domestic Prepaid	1 PH	74,931
Domestic Postpaid	1 PH	99,546
Domestic Prepaid	3 PH	461
Domestic Postpaid	3PH	85
General Prepaid	1 PH	7,500
General Postpaid	1 PH	22,811
General Prepaid	3 PH	4,500
General Postpaid	3PH	2,178
Power MD LV	3PH	851
Power MD MV	3PH	61
Exports	3PH	12
Total		212,936

2.3 Demand and Energy Profiles – 2008

Average Daily Demand Profile

The average system demand profile in 2009 is shown in Figure2.1.

Figure 2.1: Average Daily Demand Profile



The peak months are August and September when the average demand exceeds 290 MW. On average there is around 14% shortfall in capacity which is predominantly in the evening peak period (5 to 9 pm).

The forecast electricity sales to respective customers segments are given in Table 2.2.

Table 2.2: Forecast Generation and Sales

	2010	2011	2012	2013	2014
Domestic -Post	378	433	498	571	642
Domestic – Pre paid	194	215	239	265	293
General	284.77	327	377	434	492
Power LV	266.81	292	318	345	374
Power MV	384	428	474	522	572
Export	16	16	16	16	16
Total Sales	1,523.49	1,711.34	1,921.05	2,152.77	2,389.15
T&D Losses (%)	18.0%	17.0%	16.0%	16.0%	16.0%
Total Generation (GWh)	1,857.91	2,061.86	2,286.97	2,562.82	2,844.23
Maximum Demand (MW)	317	351	390	437	485
Load Factor (%)	67	67	67	67	67

The maximum demand forecasts taking into account impacts of proposed DSM programs are given in Table 2.3.

Table 2.3: Forecast Maximum Demand including DSM Programs

	2010	2011	2012	2013	2014
Projected Peak Load	317	351	390	437	485
Step Load	18	26	33	37	37
Peak load with step loads	334	377	422	474	522
DSM 1:CFL	11	16	20	20	20
DSM 2: TOU	19	21	22	24	26
Net Peak Load	304.41	339.88	380.53	430.03	475.98
Reserve	30.44	33.99	29	33	36
Generation Requirements	365	411	451	506	558

3 PROGRAM DESIGN

3.1 Rationale

The supply and demand scenarios in the Malawi Electricity Sector show a trend of significant capacity shortage in the foreseeable future, due to an increase in demand averaging 7% per year. Currently the system average peak load is around 295 MW, while the available capacity is around 255 MW which equates to a power shortage of 14%. In addition, there are around 13,000 customers waiting to be connected and ESCOM estimates the total demand to be around 334 MW. Load shedding and power outages are used extensively to ration power.

ESCOM has introduced Time of Use (TOU) tariffs as part of their Demand Side Management (DSM) strategy. However, the demand impact is around 20 MW due to the limited flexibility of load shifting. Current market data on sales of Incandescent Bulbs (IBs) still show a high penetration therefore offering potential for reducing the evening system peak demand through the promotion of Compact Fluorescent Lamps (CFLs) as a direct replacement for IBs. International programs have shown that the distribution of 1 Million CFLs will reduce ESCOM's system peak demand by an average of 30MW. Hence, a large scale CFL program aimed at replacing the bulk of the IBs would offer ESCOM a viable option of addressing the current imbalance of supply and demand.

Data provided by ESCOM show that there is an average of 6 IBs per customer in the residential sector taking into consideration security lights that are widely used and targeting the residential customers will have the biggest impact on the evening peak demand as research have shown that residential lighting to be the major contributor.

To derive the demand savings the program implementation procedures need to ensure that the existing IBs are immediately replaced by the CFLs provided under the program. Experience in other countries has shown that direct installation to be the most effective way. Allowing customers to exchange IBs for CFLs at nominated distribution centers is likely to pose a lot of risks in meeting the program objectives (demand reduction). These include the following:

- Customers could purchase new IBs in order to exchange the maximum no: of IBs allowed under the program
- Customers may not install all the CFLs collected
- Customers may keep the CFLs for replacement of low quality CFLs that they are currently using (there is no demand reduction by changing a CFL for another CFL)
- Customers may be tempted to sell the acquired CFLs (which could be subsequently smuggled to a neighboring country).

3.2 Objectives

The key objective of the program is market transformation from the use of IBs to CFLs for all consumer sectors in Malawi. The primary focus will be on the residential consumers and small enterprises where lighting is predominantly coincident with the evening peak demand.

3.3 Program Scope

The estimation of the total number of CFLs to be distributed under the program is based on the results of a previous household survey and estimates by ESCOM. In addition, feedback from the major lighting retailers in Malawi indicate that the current annual sales of IBs are around 2 to 3 million.

The Table 4.1 provides a summary of the estimated number of CFLs for the proposed program.

Table 4.1 – Estimated Size of CFL Program

Customer Category	*No: of Customers*	*Average No: of CFLs per Customer*	*Total*
Domestic Post-Paid	125,000	6	750,000
Domestic Pre-Paid	33,000	6	198,000
Domestic – Awaiting Connection	13,000	6	78,000
General – Small Enterprises	24,000	6	168,000
General – Public Sector	5,000		106,000
General – Commercial & Industrial	1,200		700,000
Total	205,200		2,000,000

Note: The rationale for 6 CFLs per customer is based on: 1 in Living/Dining, 1 bedroom, 1 kitchen, 1 bathroom and 2 security

3.4 Program Description

Target Market Segments

The program will target all customer segments of ESCOM adopting different implementation options for different customer categories. The residential (post-paid and pre-paid) small enterprises and public sector customers will involve direct installation of CFLs for existing IBs, while the other customers (large commercial and industrial) will have the option of purchasing IBs at discounted prices in the retail market. The latter segment (commercial and Industrial) include hotels, restaurants etc that are operational during the evening peak and hence, would contribute to peak reduction. Besides, the sustainability of this program is dependent on the market transformation of IBs and low quality CFLs to high quality CFLs; and this could only be achieved by targeting all customer segments and ensuring that it is market driven after the initial program.

Program Design Features

This program aims to increase the awareness and use of Compact Fluorescent Lamps (CFLs) as a replacement of Incandescent Bulbs (IBs) in all customers sectors in Malawi. The program design will address some of the barriers (primarily the high cost and low quality of CFLs) to large scale use of CFLs and establish a cost effective distribution mechanism that will significantly reduce energy consumption in the targeted sectors. The scope of the program is limited to the distribution of approximately 2.0 Million CFLs.

Based on the results of past surveys and information from retailers, around 75% of the IB sales are in the 40W to 60W range and 25% in the 75W-100W range. Hence, the wattage of the CFLs

provided under the program will include 15W CFL (for < 60W IBs) and 20W CFL (for 75W-100W IBs). The type of fitting is predominantly bayonet (pin) type but there is usage of screw (E27) fittings in mainly decorative lighting. It is therefore proposed that holders are provided for fittings that require a change from screw to bayonet.

In order to maximize the program impacts in the shortest possible time, it is proposed to adopt direct installation in the premises of residential, small enterprises and public sector. For the residential and small enterprises categories, the existing IBs will be replaced with CFLs *free-of-charge* up to a maximum of 6 CFLs per customer. In the public sector, all existing IBs will be replaced with CFLs free-of-charge.

The other customer sectors (large commercial and industrial) will have the option of purchasing CFLs from ESCOM bill payment Centers or participating retailers at a subsidised price for a limited period. This channel will also be open to other residential customers who require additional CFLs (i.e. in excess of the 6 CFLs provided free-of-charge).

Procurement: The procurement shall be via International Competitive Bidding following the guidelines of the Office of Public Procurement of the Government of Malawi. The final bid documents and contracts will require a No Objection-Letter (NOL) from the World Bank (assuming that donor funding is provided for the project).

Revolving Fund: It is proposed that the revenue generated from the sales of CFLs to the private sector is deposited in a Revolving Fund to be established by the Ministry of Finance. Upon completion of the initial phase of the program, the Project Steering Committee (see Section 4.6) shall decide on the reallocation of funds either for additional procurement of CFLs or for another EE program (e.g. Government Sector) consistent with the DSM objectives of ESCOM. A list of DSM program options is given in Section 8.

The Revolving Fund is important to ensure that the proposed CFL program is not a one-off program that addresses the short-term needs of ESCOM. The long-term aim of the CFL program is complete market transformation from IBs to CFLs; and hence, the fund would be available for another round of CFL procurement based on the evaluation of the first program. Alternately, there are several DSM program options that could compliment the CFL program, primarily in areas of commercial lighting and street-lighting. This would result in the introduction of new lighting technologies which would have a significant impact in office buildings, primarily in the public sector. Revolving Funds have been used in several countries, e.g. Vietnam where the World Bank established a fund to support their CFL program.

Disposal of IBs: It is proposed that direct installation of CFLs is adopted for the residential, small enterprises and Public Sector in exchange for existing IBs. The IBs collected shall be disabled (breaking the pin or crimping the screw threads) to ensure that they cannot be reused. A monitoring sheet shall be provided to the installers for recording the number and wattage of the IBs collected. Options for the safe disposal of IBs are given in Section 4.7.

Program Marketing: A consumer awareness program shall be undertaken targeting all customer sectors to provide information on the program and benefits. Several modes of communication (radio, newspapers and bill inserts) shall be adopted. The awareness campaign could be directed by ESCOM's Public Relations Unit with the assistance from the Consumer Welfare Association of Malawi. It is proposed that a professional agency is engaged to prepare the marketing materials for the campaign.

Program Implementation Process

The program implementation process will be as follows:

- CFLs will be procured in bulk through international tender at wholesale prices (which is approximately half the retail price).
- The CFLs will be procured in two wattages – 15W and 20W which would cover the Incandescent Bulb (IB) range up to 100W. The proposed wattages are based on customer surveys conducted by ESCOM and information from retailers. The average wattage of incandescent bulbs was determined to be around 65W. In addition, based on the overall percentage of IB wattages, the 15W and 20W CFLs will provide the maximum benefits to ESCOM.
- The CFLs procured will have a 10,000 hour life and will be backed by a two year warranty from the suppliers. Recent international procurements have adopted these specifications and major CFL manufacturers have the capacity to comply at competitive prices.
- Eligible consumers – All ESCOM's customers.
- In the residential and small enterprises sector, each consumer will be provided up to 6 CFLs in exchange up to 6 working Incandescent Bulbs (IBs). This limit could be flexible depending on the program participation rates. In the public sector, all existing IBs will be replaced by CFLs. The CFLs are provided free-of-charge to these sectors.
- For the other customers (Commercial and Industrial) there will be provision of purchasing CFLs from ESCOM or participating retail outlets at a discounted price and lamp warranty. These customers will be provided a voucher through the electricity bill entitling them to purchase CFLs during the program period. It is proposed that the retail price of the CFLs in this program will be below the current retail price of low quality CFLs (~ 300 MK).
- The exchanged IBs will be disabled (e.g. by crimping the base or bending the pin) and stored for independent verification. The IBs will be safely disposed after verification.
- The proceeds from the sale of CFLs to the private sector, via ESCOM Bill Payment Centers and retailers, will be channelled to a Revolving Fund for use of future programs as directed by the Project Steering Committee.

Summary of Program Design

A summary of the key program features is given in Table 4.2 below.

Table 4.2: Summary of CFL Program Design Features

Parameter	*Description*	*Comments*
No: of CFLs	2.0 Million	Estimates provided by ESCOM
CFL Wattage	15W (75%) and 20W (25%)	Based on the estimated market share of IB wattage and type of fitting
CFL life / warranty	10,000 hours / 2-year warranty	Normally the warranty would apply from the date of delivery
Eligibility	All ESCOM customers	
CFLs per customer	Residential and Small Enterprises – Maximum of 6 existing IBs will be replaced with CFLs Public Sector – all existing IBs will be replaced with CFLs Private Sector – Provision of purchasing	Need to exchange equivalent no: of working IBs. Limit IB wattages to 40W-100W The number of CFLs per customer could be flexible depending on the participation rates

Parameter	*Description*	*Comments*
	CFLs at discounted price from ESCOM Centers and participating retailers	
Technical Specifications	Revised ELI specifications used by SAPP for other CFL programs.	Revised for 10,000 hour lamp life and 2 year warranty
Distribution	Direct installation by ESCOM sub-contractors – the existing IBs are replaced by CFLs. Also distributed via ESCOM Centers and Retailers	Need to ensure enough resources to complete the installation within 3 months.
Program costs	CFLs are provided free-of-charge for residential, small enterprise and public buildings. CFLs sold to the private sector is likely to be below the current price of a low quality CFLs (~ 300 MK)	The revenue generated from the sale of CFLs will be deposited in a REVOLVING FUND to be maintained by Ministry of Finance.
Disposal of IBs	The IBs collected from the customer premises shall be disabled and the no: of IBs by wattage shall be recorded prior to safe disposal.	The feasible disposal option shall be determined for MNREE
Marketing and Promotion	A Consumer awareness program will be implemented in parallel with the CFL program	The program could be undertaken by ESCOM marketing and Business Development Unit in conjunction with Consumer Welfare Association of Malawi
Program Duration	1 year	It is expected that the initial procurement, distribution, monitoring and evaluation period will not exceed one year

3.5 Impacts and Outcome

Impacts

The large scale use of CFLs in the residential sector will have a significant impact on the demand-side of ESCOM's operations resulting in improved system efficiency and benefits to consumers. Lighting loads have the biggest impact in the evenings when electricity demand is at its peak and this program addresses the capacity constraints. Improved load factor will improve the overall system efficiency. The program will increase financial viability of the ESCOM since current tariffs offer subsidies to low consumption categories in the residential sector and also reduce the power outages during the evening peak period. Lighting accounts for nearly 40% of the average household electricity consumption and this program provides affordable efficient lighting to consumers resulting in lower electricity bills.

Outcome

Several international DSM Programs have shown that the CFL program has the potential to reduce 30MW of peak demand per 1 million CFLs after considering coincidence factors and system losses. In Malawi, the demand saving is expected to be higher since the system losses average 19%.

The programs in Africa to date have been implemented on an ad hoc basis and so the proposed program in Malawi incorporating higher quality CFLs (supported by an extended warranty) will act as a case study to attract electric utilities in Africa to implement similar programs. Bulk purchases directly from the manufacturers will enable the landed costs to be approximately half that of current retail prices (even lower with the duty free concessions provided in the recent Malawi budget statement). The key outcome would be the transformation of the current CFL market from high cost, low quality lamps to affordable, high quality lamps.

Outputs

The program aims to replace inefficient incandescent lamps with high efficient Compact Fluorescent Lamps (CFLs), primarily in for residential buildings and small enterprises. The distribution of CFLs would be via direct installation, free-of-charge, while the private sector will have the opportunity to purchase CFLs at subsidised prices from ESCOM and other participating retailers.

The initial scope is for 2 million CFLs and the demand reduction from the direct installation customers alone is expected to result in an overall peak load reduction of 38 MW (including coincidence factor and system losses), based on the percentages of IB wattages determined in the household survey conducted by ESCOM.

The benefits to the residential consumer will be 49 kWh/year/CFL (based on average IB wattage of 60W), which is equivalent to an annual saving of MK 276 under current electricity tariffs.

3.6 Program Management

The following program management structure is proposed:

Executing Agency (EA): Ministry of Natural Resources, Energy and Environment (MNREE)
Implementing Agency (IA): Electricity Supply Commission of Malawi (ESCOM)

A Project Steering Committee (PSC) shall be established and it is recommended that the PSC should comprise representatives from the following agencies:

- Ministry of Natural Resources, Energy and Environment (MNREE) - Chair
- Electricity Supply Commission of Malawi (ESCOM)
- Malawi Energy Regulatory Authority (MERA)
- Department of Energy (DOE)
- Ministry of Finance (MOF)
- Department of Environmental Affairs (DEA)
- Malawi Bureau of Standards (MBS)
- Consumer Association of Malawi (CAMA)
- Ministry of Industry and Trade (MoIT)
- Malawi Revenue Authority (MRA)
- Representative from the Donor Agency

The functions of the PSC include:

- Overall Program Administration
- Review and approval of Preparation of tender documentation and contracting
- Coordination of CFL distribution
- Coordination of Monitoring & Evaluation
- Dissemination
- Progress reporting to Government

3.7 Procurement

All procurement under this project shall conform to the guidelines and procedures of the Office of Public Procurement of the Government of Malawi. The Public Procurement Law, 2003 and the Public Procurement Regulations, 2004 detail the procurement processes, rules and procedures, and the procurement methods to be followed by Procuring Entities. The Public Procurement Law, 2003 and the Public Procurement Regulations, 2004 must be complied with at all times. The Standard Bidding Documents (SBD) shall conform to International Competitive Bidding (ICB).

The following procurement options are proposed:

- Selection to be based on price, technical specifications, provision of warranties and other delivery requirements. The wattages of the CFLs will be specified and determined on the assessment of current wattages of incandescent lamps that are widely used.
- The supply price is the wholesale price delivered directly to the locations proposed in the tender.

3.8 Summary of Program Costs

The program costs are based on similar international CFL programs, particularly in Philippines (in 2009) where CFLs were procured at wholesale prices by the Department of Energy (Implementing Agency) using single-source procurement. There are two other procurements currently in progress for similar programs in Pakistan and Bangladesh. Program costs will be refined, if appropriate, once contract information is known.

The following assumptions were made in estimating the unit cost of a CFL including distribution, administration and marketing:

Wholesale price	=	1.225 US$ (including freight costs, excluding VAT)
ESCOM Administration	=	0.050 US$
Distribution Cost	=	0.075 US$ (Direct installation at customer premises)
Storage & Disposal	=	0.015 US$
Marketing	=	0.050 US$
Monitoring & Evaluation	=	0.025 US$
Misc	=	0.035 US$
Contingency	=	0.025 US$
Unit Cost of CFL	=	1.500 US$

A summary of the estimated program costs are:

Item	Description	Cost (US$)
Equipment	2.0 Million CFLs	2,450,000
Program Costs	Administration	100,000
	Distribution	150,000
	Lamp Storage (CFL and IB)	15,000
	Lamp Disposal	15,000
	Marketing & Promotion	100,000
	Monitoring and Evaluation	50,000
Miscellaneous	Project Implementation Assistance	70,000
Sub Total		2,950,000
	Contingency	50,000
Total		3,000,000

3.9 CFL Market Situation in Malawi

The assessment of the current CFL market has highlighted that long life CFLs (10,000 hours) are not available in Malawi. The market is saturated with low quality CFLs sold through a series of retailers and supermarkets. The known brand names (e.g. Philips) are retailing at nearly double the cost of the low quality CFLs. Affordability is therefore a major issue in the promotion of CFLs.

The CFLs that are in the market at present have an average life of 5,000 – 6,000 hours and do not come with a warranty. Due to frequent power outages there is a tendency for customers to be wary of purchasing CFLs as they risk premature failure from power surges. However, feedback from retailers indicates that reliability is not a major factor in good quality lamps with a greater tolerance to voltage fluctuations.

In order to ensure sustainability, energy efficient lighting needs to be introduced into the market at affordable prices through a competitive private retail network. With respect to CFLs the challenge is reduce the current price of good quality CFLs to a level that is affordable to a majority of households. Simultaneously, the issue of import of low quality CFLs needs to be addressed as quality is one of the key factors influencing customers in purchase decisions.

The unit costs of CFLs have been decreasing significantly in recent years. However, bulk procurement at wholesale prices is not the optimal solution for the retail sector. Having lower retailer margins supplemented by increased volume sales has been adopted by some retailers overseas. The recent waiver of import duty on CFLs and increase in duty of IBs by the GoM is a step in the right direction although the CFL quality issues are not addressed.

The policy options complementing the proposed CFL program that should be considered for long term sustainability are given below.

Policy Options for Efficient Lighting

In order to address the current market issues, it is proposed that the GOM consider the following policy options:

1. Introduction of Minimum Energy Performance Standards (MEPS) for CFLs imported to Malawi. This could be introduced through the Malawi Bureau of Standards making it mandatory for all CFLs imported to the country to comply with MEPS.

   Numerous countries have introduced MEPS and/or product labeling programs that are either voluntary or mandatory. The Collaborative Labeling and Appliance Standards Program (CLASP) has produced a guidebook outlining the procedure for the development of energy performance standards for appliances (including lighting). Information on MEPS in other countries and specification could be obtained from http://www.clasponline.org.

   MEPS would ensure that only good quality lamps are available in the market. Mandatory standards appear to work best provided enforcement is adequately addressed.

2. Phasing Out Incandescent Bulbs – Gradual phase out of IBs from the market. Several countries (Australia, USA, European Union, Cuba, Philippines, Argentina, and Canada) have introduced IB Phase Out programs that would enhance the use of CFLs as an alternative.

3.10 Environmental Considerations

Safe disposal of spent fluorescent lighting is a critical issue from a public health perspective and the current policies and practices of Lamp Waste Management (LWM) in most African and Asian countries do not adequately address this issue. With the promotion of Energy Efficient Lighting Systems (EELs) the use of fluorescent lighting is expected to increase significantly.

Mercury is known for its high toxicity and its significant adverse impacts on human health are well documented throughout the world. Exposure to high levels of mercury can cause permanent brain damage, central nervous system disorders, memory loss, heart disease, liver damage, loss of vision, loss of sensation and tremors. In view of the enormous impact of mercury-containing waste on public health there is a need to strengthen current strategies and policies on LWM.

The Table 6.4 shows the typical mercury content of various types of mercury containing lamps.

Table 6.4: Mercury Content of specific mercury-containing Lamps

Lamp Type	Mercury content (mg)
Compact Fluorescent Lamp (CFL)	1 to 25
Linear Fluorescent Lamps	3 to 12
Mercury Vapor Lamps – 75 Watts	25
Metal Halide Lamps – 75 Watts	25
Sodium Vapor Lamps – 35 Watts	20

Most technical specifications for CFLs specify a mercury content of less than 5 mg and manufacturers do not appear to have any problems in meeting these standards. The spent (burnt) CFLs tend to have around 15% of residual mercury which if not recycled finds its way into landfill. The safe disposal methods of burnt CFLs and other FTLs should be addressed in the program marketing campaign.

As part of the Philippine Energy Efficiency Project (PEEP) a Lamp Waste Recycling Plant is being procured with a recycling capacity of up to 6 million CFLs and FTLs.

A Recycling Plant is not included in the scope for the proposed Malawi EE Lighting Program. Several African countries have undertaken energy efficient lighting programs (including CFLs) but none have the facility for recycling lamp waste primarily due the small quantities of collected busted lamps making individual facilities uneconomical. One option may be to consider a regional facility and this could be addressed through the Southern African Power Pool.

4 IMPLEMENTATION PLAN

4.1 Procurement Procedures

The Procurement Procedure shall follow the guidelines of the Government of Malawi. The procurement notice will be issued by the Executing Agency (MNREE) and the normal advertising procedures for International Competitive Bidding (ICB) shall be followed.

It is proposed that MNREE in conjunction with the Office of Public Procurement establish a Technical Working Group (TWG) for tender evaluation and contract award. In addition, the scope of responsibilities of the TWG could include the coordination of Monitoring & Evaluation activities.

The Technical specifications for the CFLs are given in *Attachment 11.2.* Draft Bidding Documents are provided as a separate attachment to this Design Report.

4.2 CFL Installation

The installation of CFLs in residential, small enterprise and public buildings shall be carried out by sub-contractors engaged by ESCOM. Considering the need to complete the installation in a short timeframe (around 3 months), it is important to have sufficient resources allocated for this task.

The installation procedure is shown in Table 5.1.

Table 5.1: CFL Installation Procedures

Step	*Description*	*Comments*
1	**Check Electricity Bill**	To confirm Customer details
2	**Check Incandescent Bulbs**	
	▪ Check if the IBs are working ▪ Check the Wattage ▪ Check type of fitting (pin or screw) ▪ Check no: of IBs to be replaced	Ensure that the IBs in high usage areas (security, lounge room, kitchen, bedroom etc) are given priority
3	**Installation of CFLs**	
	▪ < 60 W IBs to be replaced with 15W CFL ▪ > 60W IBs to be replaced with 20W CFL ▪ Existing screw light sockets are replaced with pin type socket ▪ Tear the top part of each CFL box and give	In order to maximize savings ensure that the wattage of IBs closely match the equivalent wattage of CFLs. The tearing of the top part of the box will minimize the chances of the lamps being

Step	Description	Comments
	them to the customer.	sold outside.
4	**Advice to Customer**	
	▪ Give information on the lamp warranty and instructions on procedures for obtaining replacements	The warranty card will be inside the box
5	Completion of Monitoring Sheet	
	▪ The monitoring sheet shall be completed by the Installer – customer name, account no: the no: and wattages of the IBs replaced and no: and wattages of the CFLs installed. ▪ The customer shall sign the form after completion	This information is critical for program monitoring and evaluation of savings.
6	Storage of Incandescent Bulbs (IBs)	
	▪ The IBs are disabled to prevent re-use o pin type: break or bend the pins o screw type: crimp the threads ▪ IBs are stored by wattage – one carton for each wattage ▪ Each filled box is sealed and marked – no: of IBs/Wattage ▪ The boxes are stored for safe disposal	The disposal will be undertaken by ESCOM

4.3 CFL Distribution to Private Sector

The distribution to the private sector shall be undertaken by ESCOM Bill Payment Centers and selected electrical retailers with distribution networks in the electrified areas.

To initiate this, ESCOM would be required to screen the listing under General Customer Category to identify customers outside the segments (public sector and small enterprises) that qualify for free CFLs through direct installation. These customers should be provided with a voucher, included in their electricity bill that would entitle them to purchase CFLs (at discounted prices) at the nominated outlets. The voucher (issued only one time) will be valid for the period of the program (3 months) and there should be no limitations on the number of CFLs per customer. However, in order to minimise misuse the following is proposed:

- Up to 10 CFLs: Purchase from ESCOM Bill Payment Centers and nominated Electrical Retailers.
- Greater than 10 CFLs: Purchase from ONLY ESCOM Bill Payment Centers upon confirmation of the requirements at the customers premises.

The vouchers shall be designed to provide relevant information of the program, validity period, details of outlets for purchase, cost of CFL. The vouchers shall have a section to be completed by the customer/retail outlet providing information of customer name, electricity account number, the number of CFLs purchased by wattage (15W and 20W), date of purchase and stamp of retail outlet (or ESCOM Center). These vouchers will be used for subsequent program monitoring and evaluation.

Distribution through Electrical Retailers

It is proposed that ESCOM issues an Expression of Interest (EOI) inviting submissions from retailers for participation in the program. It is important to select a few reputed retailers who have distribution outlets throughout the country. The terms and conditions of engagement shall be clearly specified and should include the following:

1. The selected retailers will have the option to purchase CFLs directly from ESCOM at the agreed subsidized price.

2. For the duration of the program (3 months) the selling price will be fixed (which would include the retailer margin). It is anticipated that the selling price would not exceed 300 MK which would be below the current market price of low quality CFLs (300 – 500 MK).

3. The retailers will be required to provide monthly sales records (including the vouchers) during the program period.

4. The warranty obligations will be met by ESCOM. If the lamps fail, the retailer will provide an immediate replacement to the customers and then send the failed CFLs to ESCOM for replacement. The warranty period is normally 2 years from the date of delivery by the manufacturer to ESCOM.

5. After the program ends, the retailers are free to sell existing stocks in the open market.

The distribution procedure is given in Table 5.2

Table 5.2: CFL Distribution Procedures

Step	*Description*	*Comments*
1	Issue Expressions of Interest	
	▪ Invite EOI's from Electrical Retailers and Supermarket chains	
2	Selection of Retailers	
	▪ Establish selection criteria ▪ Sign agreement outlining obligations of each party	Selection restricted to those having distribution network in main cities
3	Sale of CFLs to Retailers	
	▪ Retailers will purchase CFLs directly from ESCOM at a published price	Ensure fair distribution of CFLs amongst retailers

Step	Description	Comments
	▪ The no: of CFLs per retailer is not fixed ▪ The warranty obligations are with ESCOM	
4	Monitoring of Sales	
	▪ CFL sales records are provided to ESCOM every month for the program period ▪ Record of the no: of failed CFLs will also be recorded	

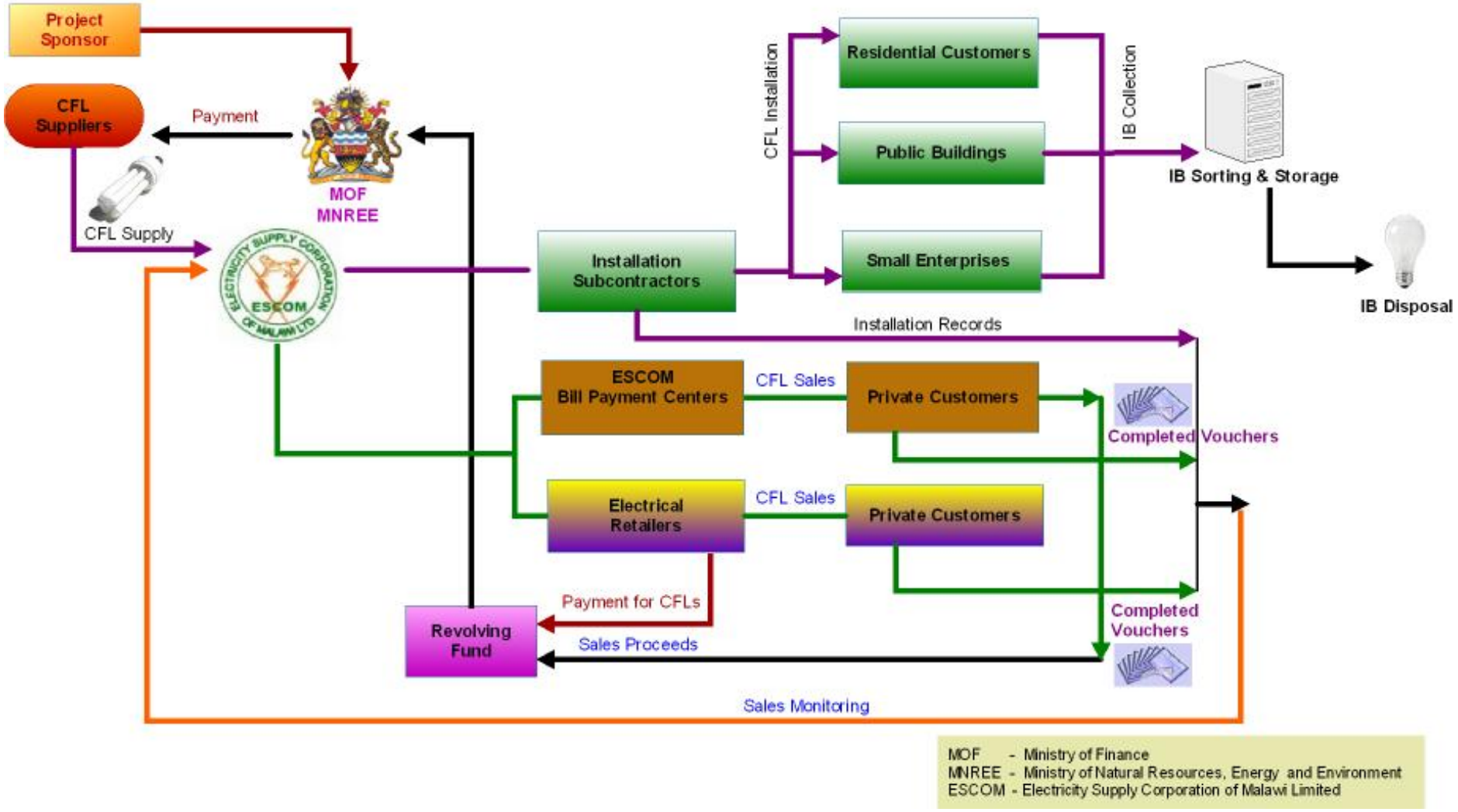
4.4 Implementation Procedure

A diagram of the implementation procedure is given in Fig 5.1

4.5 Implementation Schedule

The proposed Implementation Schedule is given in *Attachment 11.1*

Figure 5.1: CFL Program - Implementation Procedure



4.6 CFL Program Marketing and Promotion

A coordinated marketing and promotion program in parallel with the distribution of CFLs is critical to the overall success program. It is proposed that this activity is coordinated through the Customer Relations Division of ESCOM and the Consumer Welfare Association of Malawi.

Program themes and marketing strategies are normally obtained through consumer surveys. The following are some issues that have been addressed in similar programs:

- Customer Benefits (in MK) from the use of CFLs
- Key program features – Free or discounted CFLs with 2 year warranty.
- Warning against the use of low quality CFLs
- Program participation procedures
- Health and safety considerations in lamp disposal

It is proposed that a professional advertising and marketing organization is engaged for the design and implementation of the marketing program. A draft Terms of Reference is detailed in *Attachment 11.3.*

4.7 Safe Disposal of Lamps

Incandescent Bulbs

Traces of lead are found within the glass tubing inside the lamp and in the solder of all older IBs. Although there are alternatives to lead solder, its use is still prevalent and is probably the status quo in Malawi. The use of lead is prohibited in Europe (and in some other jurisdictions, such as the State of California) under the RoHS (Restrictions on the Use of Certain Hazardous Substances) Directive, but still allowed in many countries.

IBs are normally recycled to recover glass, aluminum and ceramics as there is a market value for these products. Most countries use waste recyclers for the disposal of IBs. In the Philippines (who are currently implementing a 13 Million CFL program in exchange for IBs), the proposed disposal method is via waste recyclers for the separation of glass, aluminum and ceramics, which will then be sold to identified companies for re-use in their manufacturing processes.

The disposal procedures for IBs will be developed in consultation with the key stakeholders including ESCOM, MNREE and Department of Environmental Affairs.

Fluorescent Lamps (FTLs and CFLs)

In the context of Waste Management, safe disposal of spent fluorescent lighting is a critical issue for public health and current policies and practices of Lamp Waste Management (LWM) in many countries do not adequately address this issue. With the promotion of Energy Efficient Lighting Systems (EELs) the use of fluorescent lighting is expected to increase significantly. Mercury is known for its high toxicity and its significant adverse impacts on human health are well documented throughout the world. Exposure to high levels of mercury can cause permanent brain damage, central nervous system disorders, memory loss, heart disease, liver damage, loss of vision, loss of sensation and

tremors. In view of the enormous impact of mercury-containing waste on public health there is a need to strengthen current strategies and policies on lamp waste management.

In most developing countries, spent fluorescent tubes are disposed with domestic garbage and consequently are a detriment to health. In some countries, fluorescent lamps are disposed through Hazardous Waste Management Operators. The recycling of spent FTLs offers a total solution compared to the current practice of storage, treatment and disposal, with a residual limit of 0.2 ppm of mercury. There are currently no FTL recycling facilities in many countries as there are limited volumes of spent FTLs due to inadequate collection. In the Philippines, where the estimated FTLs are around 24 million per year, the government (through the Department of Energy) is procuring a Lamp Waste Recycling Facility with a capacity of 6 million lamps. This program aims to establish the pilot recycling facility and a procedure for efficient collection of spent FTLs and operate the facility on a business model to facilitate the transfer to a private operator after a specified period.

In the case of Malawi, it would not be feasible to operate a recycling facility due to inadequate quantities of spent FTLs (and CFLs). It is proposed that a regional facility be considered through the Southern African Power Pool (SAPP).

5 MONITORING AND EVALUATION

5.1 Introduction

The proposed M&E Framework in this Section has been used for the evaluation of several large scale international CFL programs. This would need to be customized to include additional indicators proposed by the stakeholders in Malawi. Some of the suggestions made already include:

1. Change in daily load pattern
2. Reduction in power interruptions
3. Customer acceptance of the ESB
4. Measuring individual residential substation before and after implementation
5. Benefit to the economy
6. Failure rate of CFLs
7. Extent of market transformation

It is proposed that these suggestions are considered during the finalisation of the M&E Plan prior to project implementation. This activity falls under the TOR of the M&E Consultant who would review all updated information from ESCOM and the baseline survey reports prior to the preparation of the M&E Plan. This would be developed in consultation with all stakeholders.

5.2 Program Evaluation Objectives

Monitoring & Evaluation (M&E) of a CFL program has many components; Table 6.1 defines the objectives, indicates in which evaluation they will be addressed, and specifies the method to be used for the analysis.

Table 6.1: Evaluation Objectives and Methods

Program and Evaluation Objective	*Evaluation*	*Method*
Energy and Peak Savings - Determine energy (MWh) and peak demand (MW) savings associated with the program. Peak demand savings are defined as the average savings in demand that occur during the hours of ESCOM's system peak (6pm to 9pm).	Impact	Engineering Calculations using manufacturer lamp data and engineering estimates for other factors such as operating hours of lamps
Environmental benefits – determine reduced pollutant emissions - such as GHG emissions	Impact	Engineering estimates – pending availability of valid data
Program is cost effective - Evaluate cost effectiveness of program	Financial Analysis	Participant and Utility Test – pending availability of data
Reduce investment cost in power plants – evaluate impact of DSM savings on power plant building plans	Process	Survey at ESCOM – pending availability of valid data
Raise awareness of CFLs – evaluate change in	Process	Surveys of customers

consumer awareness and satisfaction with CFLs		
Improve customer service - evaluate how consumers have responded to the CFL program and their satisfaction with the program	Process	Surveys of customers
Assist poor communities – evaluate benefits to poor customers	Process	Surveys and participant test analysis
Build market for CFLs - evaluate how CFL manufacturers, distributors and retailers responded to the program and possibly changed their way of selling CFLs	Market	Surveys of manufacturers, distributors and retailers
Prepare recommendations on how could the program be improved	All	Analysis of overall evaluation results

The following sections describe the impact, process and market evaluations as well as the program cost-effectiveness analyses.

5.3 Impact Evaluation

Objectives

The primary objectives of the impact evaluation are to:

- Determine the energy savings and demand reduction associated with Program participation,
- Estimate the cost of the energy and demand reductions delivered by the Program
- Assess the cost-effectiveness of the Program as a whole.

Specific objectives of the impact evaluation are to assess:

- How cost-effective is the Program for ESCOM, Program participants and the country? Could Program cost-effectiveness be improved? If so, how?
- How many CFLs have been installed as a *direct* consequence of the Program's intervention in the market? How many CFLs have been installed as an *indirect* consequence of the Program's intervention in the market (e.g., as a result of ESCOM's endorsement of the CFLs)
- How many of the Program participants would have installed a similar number of CFLs even if the Program had not been implemented?
- How have customers' lighting loads changed as a result of installing the CFLs?
- How have customers' uses of lighting and total energy consumption for lighting changed as a result of installing the CFLs?
- Are the CFLs installed under the Program still in place? If not, why not?

Approach

Net energy savings and demand reductions attributable to the Program are derived from engineering estimates of participants' pre- and post-installation electricity consumption.

The calculation for *Total Energy Savings* is:

Total Energy Savings = (number of lamps sold/installed in program) x (average wattage of replaced IBs – wattage of CFLs) x average operating hours of lamps

The calculation for *Net Energy Savings* is:

*Net Energy Savings = (Total Energy Savings) * Net to Total Ratio/ (1-Network Loss Factor)*

The calculation for *Total Peak Demand Savings* is:

Total Peak Demand Savings = (number of lamps sold/installed in program) x (average wattage of replaced IBs – wattage of CFLs) x Coincident Factor / Power Factor

The calculation for *Net Peak Demand Savings* is:

*Net Peak Demand Savings = (Total Peak Demand Savings) * Net to Total Ratio / (1-Network Loss Factor)*

Lifetime net energy and peak demand savings should be calculated in a similar manner using, for energy savings calculation, the estimated average lifetime operating hours of the lamps.

The *Coincident Factor* is an estimate of the percentage of lamps that are operating during ESCOM's system peak demand (6 pm and 9 pm).

The *Net to Total Ratio* is an estimate of the percentage of the measured savings directly determined (the Total Savings) that actually occur due to the CFL program. Net to Total Ratio equals Net Savings divided by Total Savings. The Net to Total Ratio can be greater than 100%.

The Net to Total (NTT) Ratio this will be determined subjectively with consideration of various factors such as:

- Customers who receive CFLs but do not use them or stop using them because they are dissatisfied
- Free-riders – participants who received program incentives (free CFLs) but would have purchased CFL without incentive
- Free-drivers (customers) – participants who bought CFLs without receiving incentives but were influenced by program
- Change in operating hours after CFLs are installed – perhaps due to cost of lighting being less with CFL
- Free-drivers (manufacturers and vendors) – additional sales of CFLs because of influence of program, but not directly receive incentives
- Other factors discovered during survey process

The *Loss Factor* is used to calculate reduction in energy/ peak load due to reduced network loading and hence reduced network losses. Note that magnitude of network losses is proportional to the square of line current. Consequently a greater loss factor is generally used at the time of system peak.

The analysis for Malawi should assume that the baseline consists of IBs replaced by CFLs operating at the same number of hours and the same diversity factor, as the new CFL lamps that are installed. It is also assumed that the CFLs replace IBs that are currently working and are not additions in lighting. Annual savings will equal the savings for that year plus the savings from the prior year(s) until the operating-hour lifetime of the CFLs has expired.

The environmental benefits may be estimated for the CFL program by multiplying the energy savings by factors representing the average ESCOM emission rate of pollutants per unit of electricity delivered to their customers. The equation is:

Emissions (SO_x, NO_x, CO_2, CO, PM) = Net MWh saved x Emission Factor (tonne/MWh)

This analysis is dependent on the availability of emissions data from ESCOM or MNREE that would include average ESCOM system emission factors and information to account for transmission and distribution (T&D) losses. T&D loss information is needed because for every kWh of electricity saved at the customer site there is need to produce more electricity at the power plant to account for the T&D losses. Since the Malawi electricity sector is predominantly hydro based, the only emission reductions from the CFL program will be from diesel stand-by generators that are used by industry and commerce during power outages.

Information to determine the NTT ratio will come from surveys of participants, non-participants and others involved in the program implementation.

5.4 Process Evaluation

Objectives

The focus of the process evaluation will be to understand three key elements:

1. The level of customers' participation in and satisfaction with the Program;
2. How well specific marketing strategies worked relative to others, and
3. How effectively ESCOM's internal procedures and systems performed.

Specific objectives of the process evaluation are to assess:

- The relative differences and similarities between participants and non-participants — to ascertain if the Program has had broad market appeal rather than being limited to certain groups. The non-participants will be those private customers who did not use their vouchers to purchase CFLs from ESCOM or retailers.
- The appropriateness of various marketing materials from the perspective of customers.
- The effectiveness of Program delivery mechanisms and an assessment of Program administration and implementation issues. How else can Program design and/or marketing be improved?
- How satisfied have customers been with the CFLs and with the Program overall? What are the barriers to increased participation in the Program, as expressed by customers?
- To what extent and how do retailers believe that the Program has influenced overall market take-up of CFLs? How do the retailers and ESCOM area office personnel believe the Program could be improved?

The process evaluation will define improvements that can be made in how the program is operated. As indicated above the process evaluation will address progress with respect to the following program objectives:

- Reduce investment cost in power plants
- Raise awareness of CFLs
- Improve customer service
- Assist poor communities

In the evaluation, the specific topics that will be covered include:

- Program Design
    - The program mission
    - Assessment of program logic
    - Use of new practices or best practices
- Program Implementation
    - Quality control
    - Operational practice – how program is implemented and how CFLs are distributed
    - Program targeting, marketing, and outreach efforts
    - Program timing
- Program Administration
    - Program oversight
    - Program staffing
    - Management and staff training
    - Program information and reporting
- Market Response to Program
    - Customer interaction and satisfaction
    - Market allies interaction and satisfaction
- ESCOM Response to Program
    - Has program gained support in ESCOM and changed load forecasts used by ESCOM
    - Has program had an impact on ESCOM plans for building power plants

Approach

In order to address the objectives outlined above, quantitative and qualitative methods are used to analyse the key characteristics and behaviors of the following groups:

- Participants - residential customers (post and prepaid), small enterprises and public sector who received CFLs, and private sector consumers who purchased CFLs at discounted prices
- Non Participants – private sector customers who received vouchers from ESCOM but did not purchase CFLs during the program period
- Trade allies - suppliers and retailers of CFLs.
- Program Administrators - personnel responsible for Program implementation and management – ESCOM.

Surveys are conducted in each of the categories and a sample questionnaire for the survey is given in Attachment 11.6.

5.5 Market Evaluation

Objectives

The market evaluation is an assessment of the continuing potential for the Program to affect the market in the future, and a re-assessment of the Program's design parameters in the light of post Program participation and changes in the market. The objectives of the market evaluation specifically concentrated on understanding:

- How successfully the Program penetrated its target markets.
- The need to re-evaluate Program eligibility criteria and incentive levels.

Specific objectives of the market evaluation are to assess:

- What is the current penetration of CFLs in the marketplace? What does this imply for refinement of the Program design?
- Has the Program achieved acceptance with a broad cross-section of customers, or is it more popular with specific sub-segments? What market segments are over- and under-represented in Program participation? What does this imply for refinement of the Program design?
- How much remaining market is there for the Program? Is this remaining market potential likely to comprise customers that are essentially similar to current participants, or very different from those participants?
- If different, what are the key benefits and criteria likely to be used by those customer segments representing the Program's remaining market potential?
- How effective is the Program in transforming the existing market from low quality to high quality CFLs and affordability?

Approach

The Market Effects study will evaluate how CFL manufacturers, distributors and retailers responded to the program and possibly changed their way of selling CFLs. In particular, the evaluation will estimate whether more CFLs are being sold in Malawi as a result of the program. This will be done by evaluating how CFL manufacturers, distributors and retailers have reacted to the program and possibly changed their activities. The Market Effects evaluation will consist of surveys and market participants (manufacturers, distributors, and retailers), reviews of market sales data and analysis of the survey results and collected data.

5.6 Program Cost Effectiveness

Two financial tests will be evaluated for this program on a lifecycle basis. These two tests are the *Participant (Customer) Test* and the *Utility Cost Test*. The customer test will be evaluated for different types of customer, such as rural and city customers.

The Participant Test (PT) shows the difference between all costs paid by the customer and the energy costs savings they receive thus indicating how valuable the program is to the customer.

PT = energy cost savings to consumers during lifetime of measure ÷ total costs paid by consumer

The Utility Cost Test (UCT) shows the difference in costs paid by utility and the value of the energy they do not have to produce or buy thus indicating how valuable the program is to ESCOM.

5.7 Survey Methodology

The survey methodology is aimed at ensuring representative participation of the 3 categories of electricity customers (participants, non-participants and non-users). This methodology requires that a representative sample was selected, using random selection approach, among all electricity customers of ESCOM. No specific focus would have been given to particular user groups, namely program participating users and non-participating users. Consequently, the selected sample would have included all three groups according to their proportion in total customer population, as long as the sample was selected on scientific basis and is highly representative of the entire customer population.

The methodology includes the following;

1. Find out the following attributes of electricity customer populations in ESCOM;
    a. Average annual electricity consumption
    b. Standard deviation associated with average annual electricity consumption
2. Using statistical techniques find out the appropriate sample size for following level of precision;
    a. >90% confidence interval
    b. <10% error tolerance
3. The actual sample would be selected, using random sampling technique, from lists of customers of ESCOM's pre and post paid customers. The selected sample would include all groups of customers as above as a proportion of their respective populations.
4. The members of selected sample would be interviewed using the survey questionnaire and data would be collected and analysed accordingly.

However, if key population attributes vital for sample selection (such as average annual energy consumption and associated standard deviation for residential customers, and detailed lists of customers) are not available, then an alternative technique called "quota sampling" could be used. This technique ensures that all groups in a population are treated as sub-populations and their number in the sample is irrespective of their proportion of the total population. The inference of results is then applied after applying weights according to actual group shares. Quota sampling ensures that each group in population is appropriately numbered to produce statistically reliable results. However, one of the major disadvantages of quota sampling is that due to absence of critical weighting information, the results can not always be inferred to total population, although the results are highly reliable for the corresponding population group.

5.8 TOR for Monitoring and Evaluation

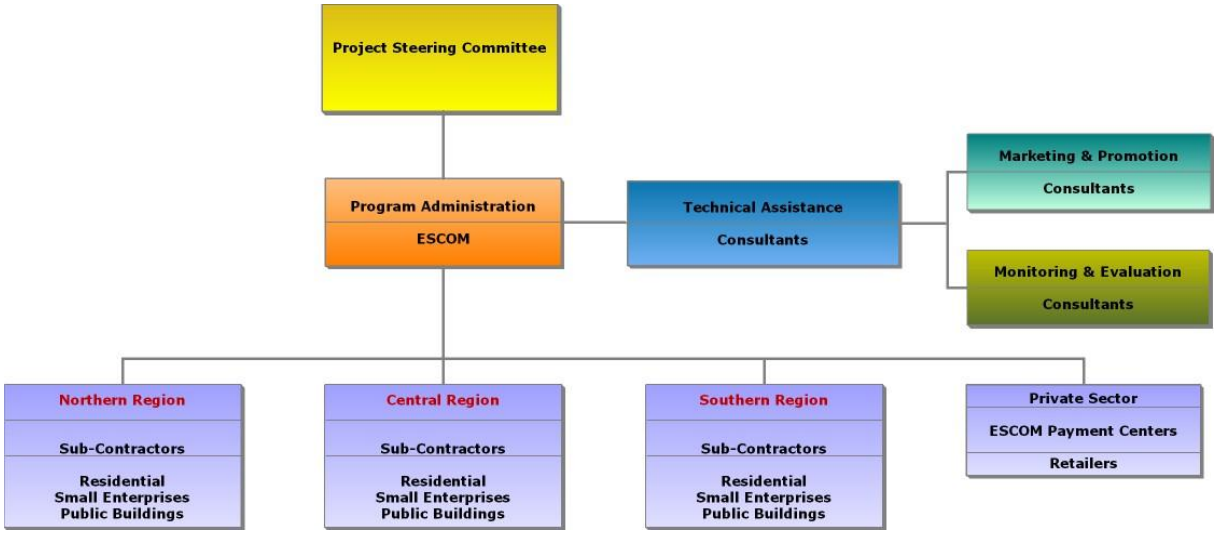
The Terms of Reference for the scope of work for Monitoring and Evaluation of the CFL Program is given in *Attachment 11.4.*

The program design is based on information provided by ESCOM and includes the results from a residential survey conducted in 1995. For M&E activities under this program it is recommended that these results are validated to establish proper baselines for evaluation of savings. A sample baseline customer survey is given in *Attachment 11.5.*

6 PROGRAM ADMINISTRATION

The proposed Program Administration structure is given in Figure 6.1 and the roles and responsibilities of each agency is described in this Section.

Figure 6.1 Program Administration Structure



6.1 Responsibilities of Project Steering Committee

It is proposed that a Project Steering Committee (PSC) is established and it is recommended that the PSC should include representatives from the following agencies:

- Ministry of Natural Resources, Energy and Environment (MNREE) - Chair
- Electricity Supply Corporation of Malawi (ESCOM)
- Malawi Energy Regulatory Authority (MERA)
- Department of Energy (DOE)
- Ministry of Finance (MOF)
- Department of Environmental Affairs (DEA)
- Malawi Bureau of Standards (MBS)
- Consumer Association of Malawi (CAMA)
- Ministry of Industry and Trade (MoIT)
- Malawi Revenue Authority (MRA)
- Representative from the Donor Agency

The final composition and structure of the PSC shall be determined by the Government of Malawi (GOM).

The functions of the PSC include:

- Overall Program Administration
- Review and approval of Preparation of tender documentation and contracting
- Coordination of CFL distribution

- Coordination of Monitoring & Evaluation
- Dissemination
- Progress reporting.

6.2 Responsibilities of ESCOM

ESCOM as the Implementing Agency will have the overall responsibility for program management and progress reporting to the PSC. The key responsibilities would include:

- Finalization of bidding documents and coordination with MNREE and Office of Public Procurement for CFL procurement, supplier selection and contract award.
- Selection and management of sub-contractors for direct installation in residential, small enterprises and public sector.
- Issue of Expression of Interest and selection of electrical retailers for sale of CFLs to the private sector.
- Management of CFL sales to the electrical retailers.
- Coordination of CFL sales through ESCOM Bill Payment Centers
- Coordination of Consumer Awareness campaign through the Public Relations Department and Consumer Welfare Association of Malawi.
- Coordination with the CFL suppliers on delivery and warranty obligations
- Establishing procedures for the safe disposal of IBs, including the preparation of an Environmental Management Plan for the project for submission to DEA.
- Preparation of monthly progress reports on CFL distribution

6.3 Responsibilities of Technical Assistance Agency

The TA shall be an independent Agency (Consulting firm) nominated by the Donor Agency and approved by the Project Steering Committee to provide management support to ESCOM for program implementation. The responsibilities include the following:

- Finalization of Bid Documents and coordination with the office of Public Procurement during the tender period.
- Assistance in bid evaluation and contract award for the CFL supplier
- Coordination with CFL supplier on delivery and warranty obligations
- Assistance in the selection of sub-contractors for installation and coordinating installation
- Assistance in the selection of electrical retailers and CFL sales to retailers.
- Coordination of the program marketing campaign
- Coordination of the program Monitoring & Evaluation activities
- Progress reporting to ESCOM

6.4 Responsibilities of CFL Retailers

The Electrical Retailers will be responsible for the overall distribution of CFLs to the private sector. They shall purchase the CFLs from ESCOM at a subsidized price and sell to the private sector at an agreed price (which includes the retail margin).

The overall responsibilities of the retailers include the following:

- Distribution of CFLs as per the agreed procedures.
- Completion of sales Monitoring Sheets
- Monthly reporting of CFL sales to ESCOM
- Coordination of CFL warranty obligations through ESCOM during the warranty period

7 PROGRAM BENEFITS AND COSTS

7.1 Customer Benefits

Based on the last customer survey conducted by ESCOM the range of IBs in the market is given in Table 8.1:

Table 8.1: Market Share of IBs

Wattage	%
40W	15.5%
60W	57.3%
75W	4.9%
100W	22.2%
Total	100%

Based on the above, the average wattage of IBs in the current market is 66W. The Table 8.2 below provides a summary of customer benefits for two IB wattages (60W and 100W) using 15W and 20W CFLs and Table 8.3 provides a summary of the overall customer benefits resulting from the program.

Table 8.2: Summary of Customer Benefits

Customer Category		Residential		SME and Public Sector		Private Sector	
Type of Replaced Lamp		IB	IB	IB	IB	IB	IB
Wattage of replaced Lamp	W	60	100	60	100	60	100
Wattage of CFL	Watts	15	20	15	20	15	20
Usage per day	Hours	3.0	3.0	3.0	3.0	3.0	3.0
CFL Lifetime	Hours	10,000	10,000	10,000	10,000	10,000	10,000
Program Cost per CFL (note 1)	$	-	-	-	-	2.00	2.00
	MK	-	-	-	-	300	300
Average Customer Tariff	c/kWh	3.74	3.74	7.54	7.54	7.54	7.54
Annual Energy Savings – per unit	kWh	49.3	87.6	49.3	87.6	49.3	87.6
Lifetime Savings – per unit	kWh	450	800	450	800	450	800
Annual Cost Saving – per unit	MK	276	491	557	991	557	991
Lifetime Cost Savings – per unit	MK	2,525	4,488	5,090	9,048	5,090	9,048
Payback to Customer	Months	-	-	-	-	6.5	3.6
Benefit / Cost ratio		-	-	-	-	17.0	30.2

Note 1: Based on selling price fixed at 300 MK per CFL

Table 8.3 – Overall Customer Benefits

Customer Category		Residential	SME & Public Sector	Private
No: of Lamps (IBs) Replaced	#	1,026,000	274,000	700,000
Cost of CFL	$	-	-	2.00
Cost of CFL	MK	-	-	300
Energy Savings per annum	MWh	69,600,000	18,600,000	47,500,000
Lifetime Energy Savings	MWh	635,300,000	169,700,000	433,400,000
Ave Customer Tariff	c/kWh	3.74	7.54	7.54
Total Cost of CFLs	$	-	-	1,400,000
Total Cost of CFLs	MK	-	-	210,00,000
Energy Cost Savings	$/yr	2,107,342	1,134,588	2,898,58
Energy Cost Savings	MK/yr	316,101,321	170,188,126	434,787,184
Lifetime Cost Savings	$	19,245,134	10,361,530	26,471,061
Lifetime Cost Savings	MK	2,886,770,058	1,554,229,564	3,970,659,215
Overall Payback Period	Months			5.80
Benefit / Cost Ratio				18.91

It should be noted that these benefits are based on the private customers purchasing the CFLs at $2.00 per CFL which include the overall cost of CFL, ESCOM mark-up and retailer margin.

7.2 ESCOM Benefits

The Table 8.4 summarises the accrued benefits to ESCOM from the CFL Program.

Table 8.4 – Summary of ESCOM Benefits

Customer Category		Residential	SME & Public Sector	Private	Overall
System Impacts					
Energy Savings	GWh/yr	71.3	19.0	48.7	139
Lifetime Energy Savings	GWh	651.4	174.0	444.4	1,270
Demand Savings	MW	39.1	10.4	26.7	76.2
Cost Benefit Analysis					
Assumptions					
Avoided Energy Costs (c/kWh)	1.35				
Avoided Capacity Costs ($/kW)	2,000				

Customer Category		Residential	SME & Public Sector	Private	Overall
Average System Loss (%)	21				
Annual Cost of Capital (%)	5				
Exchange Rate (MK/$)	150				
Results					
Avoided Energy Costs	US$	962,875	257,142	656,933	1,876,950
Avoided Capacity Costs	US$	78,163,408	20,874,048	53,327,861	152,365,317
Capacity Cost Savings Annualized	US$	6,643,890	1,774,294	4,532,868	12,951,052
Reduced Supply Costs	US$	85,770,173	22,905,485	58,517,662	167,193,320
Customer Bill Savings	US$	2,667,522	1,436,187	3,669,090	7,772,799
Net Benefit	US$	83,102,651	21,469,298	54,848,572	159,420,521
Program Costs	US$				3,000,000
CFL Sales Revenue	US$			1,050,000	1,050,000
Total Costs	US$				1,950,000
Benefit / Cost Ratio					81.75

The results indicate a benefit/cost ratio for ESCOM of 81.75 when considering the potential revenues from the sale of CFLs to the private sector.

It should be noted that the potential demand savings average 38 MW per 1 Million CFLs at the generation level when considering the current system losses of around 21%.

The estimated overall demand savings of 76.2 MW is based on the assumption that the CFLs procured will be replacing IBs. This may be true for the direct installation categories (residential, small enterprises and public sector). However, the CFLs that are sold by the retailers to the private sector the use may be for replacement of IBs, replacement for low quality CFLs and new fittings. In the short term the majority of the demand savings would be achieved through direct installation.

7.3 Summary of Financial Analysis

This section provides a summary of the financial analysis from the customer and ESCOM perspectives based on the existing electricity tariffs.

Customer Perspective

	CFLs	Savings (Gwh/yr)	Years	Tariff (c/kWh)	Savings ($M/yr))
Residential	1,026,000	71.30	9.13	3.74	2.67
Small Enterprises & Public Sector	274,000	19.00	9.13	7.54	1.43
Private sector	700,000	48.70	9.13	7.54	3.67
Total	2,000,000	139.00			7.77
Discount Rate	8.5%				

	0 2011	1 2012	2 2013	3 2014	4 2015	5 2016	6 2017	7 2018	8 2019	9 2020	10 2021
Annual Energy Savings ($M/year)		4.66	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	3.71
Discount Factor	1.0000	0.9217	0.8495	0.7829	0.7216	0.6650	0.6129	0.5649	0.5207	0.4799	0.4423
Discounted Present Value	-	4.30	6.60	6.08	5.61	5.17	4.76	4.39	4.05	3.73	1.64
Net Present Value ($M)	44.69										

ESCOM Perspective

	Rate	Savings	Savings ($M/yr))
Avoided Energy Costs (GWh)	1.35 c/kWh	139.00	1.88
Avoided Capacity Costs (MW)	2,000 $/kW	76.20	152.40
Avoided Cost of Capital	8.5%		12.95
Project Life (years)	9.13		
Red Supply Costs			167.19
Cust Bill Savings			7.77
Net Benefit			159.42
Revenue from CFL Sales			1.05
Discount rate	8.5%		

	0 2011	1 2012	2 2013	3 2014	4 2015	5 2016	6 2017	7 2018	8 2019	9 2020	10 2021
Avoided Energy Costs ($M)	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	0.24	-
Avoided Capacity Costs ($M)	152.40	0									
Avoided Cost of Capital ($M)	12.95	12.44	11.92	11.40	10.88	10.36	9.85	9.33	8.81	8.29	7.77
Cust Bill Savings		(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(1.01)
Investment Cost ($M)	(3.00)	-									
CFL Sales Revenue	1.05										
Total	165.28	6.54	6.02	5.50	4.99	4.47	3.95	3.43	2.91	0.76	6.76
Discount Factor	1.0000	0.9217	0.8495	0.7829	0.7216	0.6650	0.6129	0.5649	0.5207	0.4799	0.4423
Discounted Present Value ($M)	165.28	6.03	5.12	4.31	3.60	2.97	2.42	1.94	1.52	0.37	2.99
Net Present Value ($M)	196.54										

Sensitivity Analysis

Discount Rate	NPV ($M)
8.50%	198.5
9.00%	197.9
10.00%	196.8
8.00%	199.1
7.50%	199.8
7.00%	200.4

7.4 Overall Program Costs

A summary of the estimated program costs are:

Item	Description	Cost (US$)	Assumptions and Comments
Equipment	2 Million CFLs	2,450,000	Unit price $1.225 excluding VAT landed cost in Malawi
Program Costs	Administration	100,000	Cost of additional resources at ESCOM for program administration
	Distribution	150,000	Costs of sub-contractors for direct installation
	Lamp storage (CFL & IBs)	15,000	Storage costs of CFLs and exchanged IBs
	Lamp Disposal (IBs)	15,000	Safe disposal of IBs after verification
	Marketing & Promotion	100,000	marketing & promotion campaign
	Monitoring & Evaluation	50,000	Consultancy for M&E activities
Miscellaneous	TA for Implementation	70,000	Consultancy services for implementation support (if required)
	Contingency	50,000	
Total		3,000,000	

8 DEMAND-SIDE MANAGEMENT OPPORTUNITIES

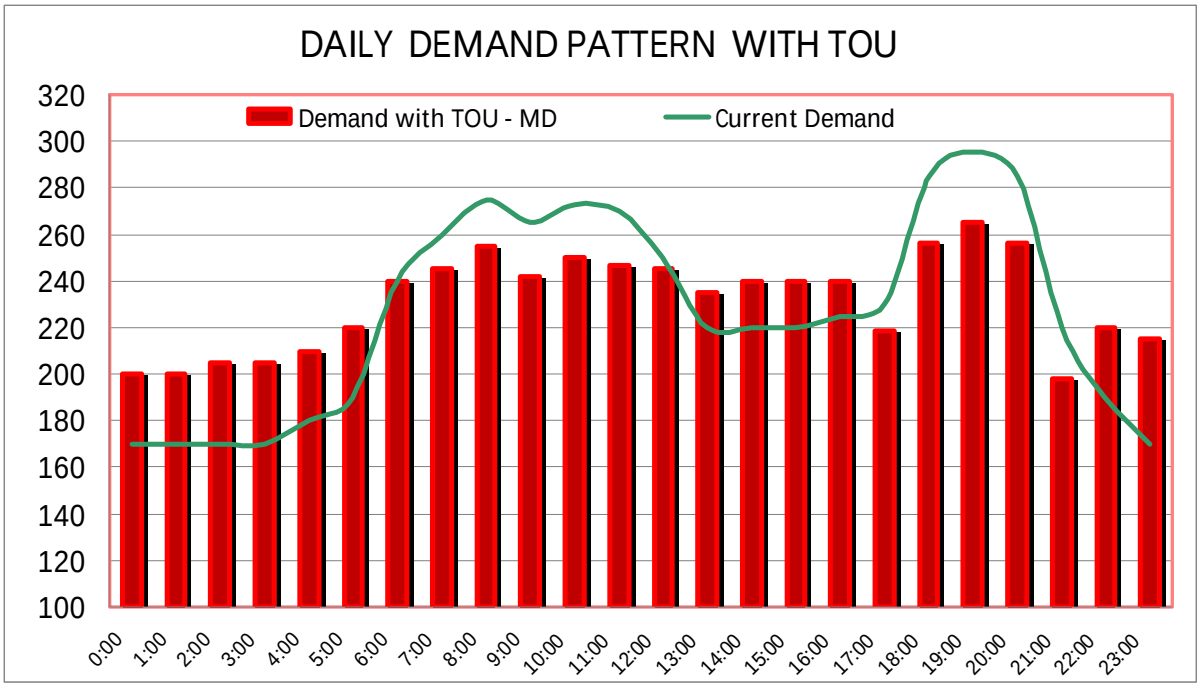
8.1 Background

To address the current capacity constraints, the Government of Malawi (GOM) through ESCOM has initiated some Demand-side Management (DSM) activities to achieve around 50 MW of demand reduction. These include:

- Introduction of Time-of-Use tariff
- CFL Distribution Program
- Reduction of transmission and distribution losses (proposed)

8.2 Impact of Current Programs

Time of Use Tariff: The TOU tariff applies to industrial and commercial customers with a connected load exceeding 50 kW. A higher tariff is levied during the peak periods (7 am to 12 noon and 5 pm to 8 pm) and a lower tariff for the remaining periods. The strategy is to encourage customers to shift load from the system peak periods to off-peak periods. However, considering that most of the industrial/commercial operations occur during daytime (6am to 6pm), it is likely that the ability to shift load to system off-peak periods will be somewhat limited. The current daily load profile (see below) shows two system peaks with the evening peak being dominant.



In order that economic activity is not inhibited the aim should be to have one peak period (evening – 5-8 pm) so that industrial/commercial customers could shift non-essential load between 8 pm and 7 am when there is sufficient supply capacity.

CFL Program: The proposed CFL program will essentially target the evening peak demand where residential lighting is the major contributor. The CFL program will have a negligible impact on the

morning peak where the industrial/commercial activities dominate. ESCOM estimates that the residential demand will increase on average by 5 MW every year through new connections and hence the evening peak will tend to dominate in the foreseeable future.

8.3 DSM Opportunities

There are several other DSM opportunities that could be considered when addressing the current supply / demand imbalance and growth scenarios so as not to impact on ESCOM's financial performance. The Table 10.1 provides a list of program options that could be considered for a sustainable DSM program in Malawi.

Table 10.1: DSM Program Options

Category	Activity	Key Features
Planning	Establishment of DSM Cell	DSM cell to be located at ESCOM with resources provided by MNREE and DOE. Build capacity of the DSM Cell in program design, implementation, monitoring & verification and program management
Planning	Energy Database	Energy end use database in all consumer sectors populated using ESCOM information, surveys and load research. The database to be used for DSM planning
DSM Program	Residential Efficient Lighting Program	Large Scale CFL Program – expansion of current program to ensure market saturation
DSM Program	Solar Hot water Program	Promote the use of SHW systems in place of electric water heaters (Geysers) in residential and commercial sectors. This is likely to reduce the morning peak.
DSM Program	Industrial / Commercial Energy Efficiency Program	Capacity building and incentives for building owners and ESCOs for implementing EE projects
DSM Program	Air Conditioner Operation & Maintenance Program	Demonstration of savings from AC controls and regular maintenance
DSM Program	Public Buildings Efficient Lighting Program	Retrofit of government buildings with efficient lighting and electronic ballasts
DSM Program	Public Lighting Program	Promotion and standardization of EE lighting in public areas and street-lighting
DSM Program	Customer Awareness and Behavior Program	Customer education programs in all consumer sectors
DSM Program	Appliance Standards and Labelling Program	Introduction of minimum energy performance standards and labels for selected appliances
Planning	Long-term Strategy for DSM	Review initial programs and develop long-term Strategy and Plan for DSM

8.4 Implementation Approach

In order to develop a sustainable DSM Program in Malawi it is proposed that a Roadmap for DSM Implementation is developed. This roadmap could be used for sourcing funds for implementation. A Roadmap would essentially comprise of the following:

- Rationale for DSM in Malawi and defined DSM objectives
- Preliminary design of DSM programs and capacity building activities
- Action Plan for DSM Program implementation – Phase 1 and 2
- Institutional Arrangements
- Implementation Budget

9 ATTACHMENTS

11.1	SUMMARY OF STAKEHOLDER CONSULTATIONS
11.2	RELEVANT INTERNATIONAL EXPERIENCE
11.3	PROGRAM IMPLEMENTATION SCHEDULE
11.4	TECHNICAL SPECIFICATIONS FOR CFLS
11.5	TERMS OF REFERENCE FOR CONSUMER AWARENESS PROGRAM
11.6	CONSUMER AWARENESS SURVEY FORM
11.7	CFL DISTRIBUTION MONITORING FORM
11.8	POST INSTALLATION SURVEY FORM
11.9	PROGRAM COST BENEFIT ANALYSIS

CFL Procurement Bid Documents (separate attachment)

9.1 Summary of Stakeholder Consultations

As a part of the design process, several meetings were conducted with stakeholders to understand the current energy sector issues and priorities, their experiences in promoting CFLs and to solicit ideas that would enhance the design of the large-scale CFL program. Information on the stakeholders and a summary of the outcomes is given in this Section.

Consultations with Government Agencies

Consultation meetings were held with the following:

#	Name of Agency	Contact Person	Position	Date of Meeting
1`	Department of Energy	Mr. Gideon Nyirongo	Director of Energy Affairs	14 June '10
2	Ministry of Natural Resources, Environment and Energy	Mr. Radson Mawadiwa	Principal Secretary	14 June'10
3	Ministry of Finance	Hon. Ken E Kandodo	Minister of Finance	14 June'10
4	Electricity Supply Commission of Malawi	Mr. Arthur Mandambwe	Acting CEO	16 June'10
		Mr. Wiseman Kabwazi	Marketing Manager	16 June'10
5	Office of Public Procurement	Mr. Isaac Z. Chilima	Deputy Director	16 June'10
6	Malawi Energy Regulatory Authority	Mr. Welton Salwa	Acting General Manager	17 June'10

Summary of Meetings

- The CFL program was announced in the recent budget statement and there is a desire for it to be implemented as a matter of priority to address the current supply problems.
- The program is to be implemented by ESCOM with MNREE acting as the Executing Agency on behalf of the Government of Malawi.
- Assistance from DFID and/or other donor agencies would be required for implementation.
- Environmental issues in relation to disposal of IBs and fluorescent lamps need to be addressed.
- Policy issues to support CFL quality, namely minimum energy performance standards and phasing out of IBs, should be considered.
- The procurement of CFLs should conform to the government procedures via the Office of Public Procurement. International Competitive Bidding (ICB) would be the most appropriate.
- Direct installation in customer premises is to be considered in order to maximize the demand impacts in a short time.

Consultations with CFL Retailers and End-Users

Consultation meetings were held with the following:

#	Company	Contact Person	Position	Date of Meeting
1	Malawi Property Investments	Mrs. Ellen Nyasulu	Facilities Manager	15 June '10
2	Energy Link (Malawi) Ltd	Mr. Naresh Daxini	General Manager	15 June '10
3	Pacific Hotel	Mr. Farooq Ahmed	General Manager	15 June'10
4	Central African Wilderness Safaris	Mr. Chris Badger	Managing Director	15 June ' 10
5	A.T. Carter	Mr. Akbar Raidhan	Director	15 June'10
6	Electra-Sales	Mr. Mustaq Aziz	Manager	15 June'10
7	Shop-Rite Supermarket			15 June '10
8	Chipiku Stores	Mr. Peter Kemp	General Manager	15 June'10

Summary of Meetings

- Most CFLs in the current market are of low quality, retailing in the range of 300 to 500 MK while the IBs retail at around 50 – 75 MK.
- The high quality branded CFLs are retailing in the range of 650 – 850 MK
- Retailers are in support of introducing energy performance standards, as low quality CFLs are hampering the acceptance of CFLs as an alternative to IBs.
- Most retailers are supportive of the proposed program and are willing to participate as distributors.
- Malawi Property Investments proposed the conduct of information seminars on energy efficiency for architects, engineers and surveyors.

Consultations with Donor Agencies

Consultation meetings were held with the following:

#	Agency	Contact Person	Position	Date of Meeting
1	Department for International Development	Mr. David Woolnough	Growth & Resilience Team Leader	14 June'10
2	Millennium Challenge Account - Malawi	Mr. Overton Mandalasi	Power Sector Specialist	16 June '10
3	World Bank	Brian G. Mtonya	Senior Private Sector Development Specialist	16 June'10

Summary of Meetings

- This is a government driven program with the overall aim of reducing the peak demand by around 50 MW.
- The preference is for a Utility/Market driven program with participation of selected electrical retailers with a wide distribution network.

- Procurement of CFLs should follow government procedures
- Need to ensure project sustainability by addressing lamp quality issues and pricing.
- Lamp waste disposal options should be addressed in coordination with the Department of Environmental Affairs
- Professional services should be considered for program marketing and promotion.

Mission Debriefing Meeting

The Mission debriefing meeting was held on 17 June 2010 at the Department of Finance and was attended by the following:

#	Name	Position	Agency
1	Mr. Joseph Mwanamvekha	Secretary to the Treasury	Treasury
2	Mr. Tomics Kaunda	Controller of Policy and Planning	MNREE
3	Mr. Peter Simbani	Director, Debt and Aid Division	Ministry of Finance
4	Mr. Timothy Makamba	Deputy Director, Revenue Division	Ministry of Finance
5	Mr. Levie Sato	Special Advisor	Ministry of Finance
6	Mr. Nations Msowoya	Asst. Director, Debt and Aid Division	Ministry of Finance
7	Mr. Arthur Mandambwe	Acting Chief Executive Officer	ESCOM
8	Mr. Gideon G. Nyirongo	Director of Energy Affairs	Department of Energy Affairs
9	Mr. Wilfred Kasakula	Senior Engineer, Renewable Energy	MERA
10	Mr. Overton Mandalasi	Power Sector Specialist	MCA - Malawi
11	Mr. David Woolnough	Growth & Resilience Team Leader	DFID
12	Ms. Sarah Hennell		DFID
13	Mr. Chris Phiri		DFID

Summary of Meeting

- The purpose of the meeting was to present the preliminary findings of the stakeholder meeting and to discuss the proposed overall framework for the design of the CFL Program.
- There was general agreement with the overall design concept and some refinements were proposed pertaining to the number of CFLs to be allocated to each household.
- It was confirmed that VAT would not apply to the procurement of CFLs but would be applicable for services (e.g. installation) under the project.
- A similar meeting will be convened in early July 2010 to review the Consultant's design report in order to finalise the report by mid July 2010.

9.2 Relevant International Experience

Utility or Agency Driven CFL Programs

Vietnam

Vietnam is one of the first countries to use sole-source bulk procurement for their CFL programs and this approach has been adopted in many countries. The approach of using multiple procurements provides opportunities for suppliers to participate in competitive tenders. This approach was used in Phase 2 DSM Program of EVN which provided a grant from the Global Environment Facility where procurement lots of 300,000 and 700,000 was sourced during 2006-07. The cost of CFLs procured was around half the retail price and EVN was able to sell at a heavily discounted price (compared to the retail price) after including costs for distribution, program administration and marketing.

The eligibility of CFL Programs under the Clean Development Mechanism has seen the development of several national programs. A summary of a few programs in Asia are given below:

Philippines

- The Government of Philippines (through the Department of Energy) is implementing a 13 Million CFL programs targeting the residential and small commercial sector nation-wide
- The procurement will be in 3 Lots – 5, 3 and 5 Million CFLs respectively.
- Up to 4 CFLs will be provided *free-of-charge* per customer in exchange for equivalent number of IBs
- CFL distribution is via the distribution utilities and electric cooperatives
- The program is designed under CDM guidelines and will be implemented over a period of 2 years.
- The program is funded through a loan from the Asian Development Bank and assistance is provided by ADB's Asia Pacific Carbon Fund (APCF) for CDM project design and registration.

Bangladesh

The World Bank (WB) is assisting the Government of Bangladesh in implementing a large scale CFL program of 26.5 Million lamps in two phases. The first phase will include the distribution of 10.5 Million CFLs and the second phase will include 16 Million CFLs. The program will be implemented by the Rural Electrification Board (REB) with a loan from the WB.

The program plan includes the *distribution of CFLs in a single day* in February 2010 and each household in rural and urban areas will receive *2 CFLs free of charge*. The CFL specification will include lamp life of 10,000 hours, power factor of 0.8 and two wattages (13-14W and 20-23W). The estimated overall program budget is $17.1 Million for the 10.5 Million lamps in Phase 1. The estimated demand savings are in the order of 350 MW.

Pakistan

The Asian Development Bank (ADB) is assisting the Government of Pakistan in implementing a 30 Million CFL Program in two Phases (10 Million and 20 Million). The project is to be implemented through the Karachi Electricity Supply Company (KESC) and eight Distribution Companies aimed at saving 1,098 MW of peak demand and 2,132 GWh annually. The main program features are as follows:

- The technical specifications include 10,000 hours and power factor >0.5 and a 2 year warranty
- The customers are sent a tear-off voucher in their electricity bill for use in the program
- CFLs are provided free-of-charge and will be brought to the customer premises and directly exchanged for IBs.
- The project is designed as a CDM Project using AMS.II.J methodology

Market Driven CFL Programs

Sri Lanka

- The Ceylon Electricity Board (CEB) was the first utility in Asia to undertake a large-scale CFL Program. The program commenced in 1997 and is still ongoing. Around 35MW of peak load reduction was achieved in the first 3 years of the program.
- Key program features – Participation by only reputed CFL suppliers backed up by 1-2 year lamp warranty. CEB offered subsidy (17% VAT exemption) and provision of interest free repayment over 12 months through electricity bills. Program marketing though centralized budget with contributions from the participating CFL suppliers. Only residential customers without any arrears in electricity bills are eligible to participate.
- The program is now totally market driven with the CEB only offering to collect payments through installments in electricity bills.

India

- The Bangalore Electricity Supply Company (BESCOM) initiated a CFL Program in 2005 using a similar model to Sri Lanka. The initial program was in Bangalore City (~ 1.3M consumers) and been expanded to 5 other cities (~3M consumers). Around 17MW of peak load reduction was achieved within one year in Phase 1.
- Key program features are – facility to pay in installments (over 9 months); pre-selection of CFL suppliers; distribution through retailer outlets; significant discount (~25% of retail price) for outright purchase; nominal finance charge for installments (still lower than retail price); totally market driven (CFL costs vary and consumers can pick the brand); and 1 year warranty.
- Several other private and state electric utilities are considering similar CFL programs.

Thailand

- CFL promotion has been through awareness campaigns undertaken by the utility (Electricity Generating Authority of Thailand -EGAT).
- Recently a program to distribute (free of charge) 800,000 CFLs was undertaken by the Ministry of Energy and EGAT. Lamp procurement is through the Energy Conservation Fund (ECF). This is a one-off program and there are no plans for replication.

Relevant Programs in Africa

Ethiopia

- Utility driven program implemented through the Ethiopian Electric Power Corporation (EEPCo) in 2008. The program is funded by the World Bank.
- The total program is 4 Million CFLs with the first phase of 350,000.

- The CFLs are distributed the residential customers free (4 CFLs per customer) through the local utility offices.

Ghana

- Utility driven program implemented through the Electric Company of Ghana.
- CFLs are offered at subsidized prices and part of the costs are recovered through Carbon Finance (CDM)

Kenya

- This program commenced in 2009 and is a Utility driven program implemented through the Kenya Power and Lighting Company
- The program targets 1.25 Million CFLs with a projected demand saving of 49MW. The CFLs are provided in exchange for IBs at designated distribution centers.

Rwanda

- This program commenced in 2008 and is implemented through the electric utility (Electrogaz) targeting the residential sector.
- The program is in 3 phases of a total of 400,000 CFLs and are distributed free at the bill payment centers

Senegal

- This five year program (2008 – 2013) is implemented by the Senegalese Rural Electrification Agency (ASER).
- The scope is 1.5 Million CFLs to be distributed to newly electrified rural households and buildings

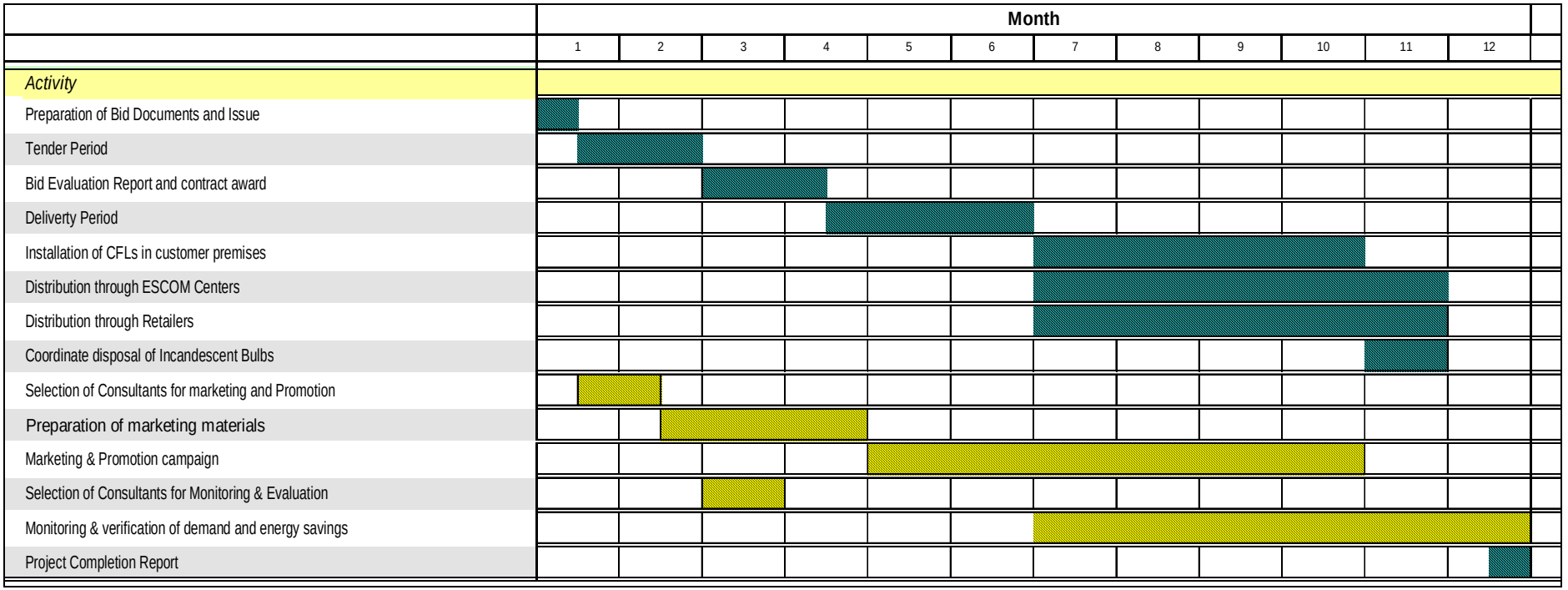
South Africa

- The program commenced in January 2000 and implemented through Bonesa (a JV of ESKOM, African Engineering and Umongl-Karebo) supported by 24% grant from GEF and 76% from ESKOM.
- The program involves direct installation at customer premises and provided free to rural low-income residential customers.

Uganda

- This program was implemented by the Ministry of Energy and Mineral Development (MEMD) in 2006 targeting 800,000 CFLs
- Each household was provided with 3 CFLs free and was directly installed in the households.

9.3 Program Implementation Schedule



9.4 CFL Technical Specifications

1. GENERAL DESIGN

The compact fluorescent lamps (CFLs) must be unitary (a single, non-separable unit containing lamp and ballast, often referred to as *self-ballasted*) and designed for applications furnished with a bayonet socket originally intended to operate standard incandescent bulbs.

Parts	Description/Type
Wattage Rating	15 and 20W
Unit	Unitary/Self-ballasted
Lamp length (L)	≤ 170 millimetres from base to tip of lamp
Ballast	Electronic
Base	Bayonet: B 22
Tube	U-shaped or spiral bare lamps

The compact fluorescent lamps must be adaptable to tropical and humid weather site conditions:

- Maximum ambient temperature: 40 ^{o}C
- Relative humidity: 85 %

2. TECHNICAL SPECIFICATIONS

2.1 Laboratory and Test Requirements

Laboratory and Test Requirements	Performance Specifications
Laboratory Facility	Must be accredited according to ISO/IEC 17025 or equivalent standard and qualified for pertinent lighting product tests by a recognized national or regional accreditation body. Accreditation document must be provided to the Purchaser.
Testing Conditions	Performed at 25 ^{o} C in an atmosphere with maximum relative humidity of 65%.
Position and Initial Burn-in	Measurements should be recorded from products in the Vertical Base Up (VBU) position, after an initial burn-in period of 1000 hours at stabilized input voltage.
Test Data and Sample Size	Test data must be from the model for which qualification is sought. Values indicated on the application form shall be calculated as the average of the data from all units tested. The sample size is 20 lamps per batch.
Longevity of Test Results	Test results must be less than two years old.

2.2 Efficiency Specifications

Efficiency Specifications
The CFL package must clearly state the performance of the following characteristics, as defined in IEC 60969, or equivalent: o Rated input power in watts, and o Light output in lumens. Efficiency shall be calculated from luminous flux and input power for the specific lamp and ballast combination in the CFL, measured at 25 ^{o}C and at a test voltage of 230V. To qualify, CFLs shall meet the following minimums: o At input power of <15 W: ≥ 52 lm/W o At input power of ≥15 W: ≥ 57 lm/W

Power Characteristics

Power Characteristics	Performance Specifications
Input Power	Input power required to achieve the specified luminous flux.
Power Factor	Measured in vertical base up position as defined in IEC 61000 or equivalent, CFLs must have a power factor of 0.5 or greater at maximum power.
Harmonics	Shall comply with harmonic current limits set by IEC 61000-3-2
Tolerance of Voltage Variation	Manufacturers must state in the application that CFLs will perform within specified parameters at a range from 200V to 250 V without a reduction in the rated life.
Transient Protection	CFL must comply with IEC 61547, or equivalent.

Operating Characteristics

Operating Characteristics	Performance Specifications
Lamp Start	CFL must continuously illuminate within 1.5 seconds of being switched on at minimum rated starting temperature and maximum power. Prior to measurement, CFL must be switched off for at least 30 minutes.
Rated Operating Temperatures	The minimum rated starting temperature must not be higher than 5 ^{o}C.

Operating Characteristics	Performance Specifications
Lifetime	CFL must have a minimum rated lifetime of 10,000 hours as defined in IEC 60969, or equivalent. *CFL lifetime shall be clearly indicated in hours on product packaging.*
Safety	CFLs must meet the requirements of IEC 60968, or equivalent.

Light Characteristics

Light Characteristics	Performance Specifications
Rated Luminous Flux	*Rated Luminous flux of CFLs,* as defined in IEC 60969 or equivalent.
Luminous Flux	The luminous flux of CFLs, as defined in IEC 60969 or equivalent, must be ≥ 760 lumens for 15W and ≥ 1100 for 20W
Correlated Colour Temperature	*Correlated Colour temperature (CCT) of the CFL must appear on product packaging* (as defined in IEC 60969, or equivalent, and measured in accordance with IES LM-16-1984, or equivalent). The CFLs supplied shall be "daylight" colour temperature (5500 K to 6500 K).
Colour Rendering Index	Colour Rendering Index (CRI) of at least 80 (as defined in IEC 60969 or equivalent, measured in accordance with CIE 13.3).
Lumen Maintenance	The luminous flux of CFLs must be ≥ 80% of initial levels at 40% of the lamp's rated lifetime. Luminous flux shall be measured according to IEC 60969.
Stabilized Light Output	The time to 75% of stabilized light output after switch-on shall not exceed 100 seconds, or, the time to 80% of stabilized light output after switch-on shall not exceed 120 seconds (measured in accordance with IEC 60969, or equivalent).

Other Specifications

Other	Performance Specifications
Lamp Packaging	A high resolution copy of the design of the Lamp Package and the wording on the CFL will be provided.

Other	Performance Specifications
	A *Hologram* showing the Malawi CFL Program logo, Supplier name and serial number of the lamp shall be adhered to the base of the lamp. In addition, the base of the lamp will be stamped with a sign *"Not for Re-sale"*.
Warranty	Manufacturer must provide a lamp warranty for the CFL (with rated life of 10,000 hours) for a minimum period of 24 months. The warranty shall be from the date that the goods are accepted by the Purchaser. During this period, the Purchaser may return defective lamps to the Supplier for replacement.
Warranty Bond	A Warranty Bond of *[$ amount to be specified]* shall be provided. Fifty percent (50%) of the bond would be released after one year and the balance after expiry of the warranty period (2 years).
Quality of Production	CFLs must be manufactured under a Quality Assurance System in accordance with ISO 9001-2000 or equivalent.
Certification	Certification from internationally accredited testing laboratories will be accepted provided that the same laboratories are duly recognized under APLAC/ILAC.
Drawings	The design of the CFL Box, Program Logo and Warranty Card will be provided with the bidding documents.

9.5 Terms of Reference for CFL Marketing and Promotion Program

Background

The Government of Malawi, facing a gap between the supply and demand for electricity, is embarking upon an energy efficiency program. A key element of this program is the bulk procurement and distribution of Compact Fluorescent Lamps (CFL), also known as Energy Saver Lamps. The CFL Program will be launched and managed by ESCOM using funds provided by international agencies.

The CFL Program consists of the following major components:

- CFL Bulk Procurement
- CFL distribution and installation
- CFL Marketing and Promotion
- Monitoring and Evaluation

This document specifies the Terms of Reference for the CFL Marketing and Promotion

Objective

The primary objectives of the assignment are to:

- Carry out a market survey of producers and suppliers to obtain information on factors influencing consumer acceptance of CFLs
- Review CFL program marketing approaches that have been implemented in other countries in Africa and Asia (Vietnam, Philippines, Bangladesh and India)
- Develop an approach to inform and educate the consumers of the benefits of CFL and to also inform them of the ESCOM CFL distribution and installation program
- Design a marketing and promotion campaign and develop appropriate materials for customer information and education
- Implement the marketing and promotion campaign for the CFL program

Tasks

Task 1 - Survey of Consumer Preferences and Market Barriers

The consultant shall conduct a quick market survey to determine:

- What types of lamps are being sold in the market
- Whether customers are purchasing CFLs
- What types of CFLs are being purchased
- What are the barriers to the purchase of CFLs

Task 2 - Review of International Experience with CFL Program Marketing Approaches

The consultant shall review the success of CFL program marketing approaches that have been implemented in other countries (such as South Africa, Sri Lanka, India, Philippines, Vietnam, Thailand) based on available data and literature. This review will be used to provide input to the design of the marketing approach and message to the consumers.

Task 3 - Develop a CFL Marketing and Promotion Strategy

Based on the results of the survey in Task 1, the review in Task 2 and in close cooperation with ESCOM and the Consumer Welfare Association of Malawi (CWAM), the Consultant shall design a CFL marketing and promotion strategy that will focus on informing and educating the consumers on the benefits of CFLs and defining the ESCOM's bulk purchase, installation and distribution program. The Consultant shall consider different approaches for consumer education and information, including radio broadcasts, leaflets, banners, billboards posters, program logos, and other media to promote the awareness and benefits of CFLs. The Consultant shall design the appropriate marketing message and the related marketing materials and review these with ESCOM. In designing the program and the materials, the Consultant shall take into account the characteristics of the target consumer groups. For example, the program will be targeted primarily at residential customers with free CFLs, while the private sector customers will be offered subsidised prices. The Consultant shall develop different approaches strategies and materials for the different target groups. The Consultant shall finalize the strategy and materials after consultations with ESCOM and CWAM.

Task 4 - Implement CFL Marketing and Promotion

The Consultant shall implement the marketing and promotion program in coordination with the CFL distribution and installation being conducted by ESCOM (through its contractors). The Consultant shall monitor the receipt of the marketing materials by the target audience and shall attempt to measure and document the impact of the marketing and promotion campaign on the consumers. The Consultant shall also document the lessons learned in order to improve the campaign in future programs.

Task 5 - Final Report

The Consultant shall prepare and submit a Final Report documenting all activities conducted, results achieved and lessons learned.

Qualifications and Experience

The Consultant's Team Leader will be responsible for delivery of all Tasks and Deliverables set out in this TOR. Throughout assignment, the Team Leader will report to ESCOM. The Team Leader will be responsible for the work of each team member and for ensuring quality services being provided by the team.

The Team Leader will have at the minimum

- Demonstrated experience at a senior level in marketing and promotion, with an emphasis on mass market and consumer promotion campaigns
- Bachelor's degree in a field related to marketing and promotion;
- Malawi national preferred; and
- Minimum five years experience in the field of advertising, marketing, promotion, or public relations, with at least two years experience in Malawi.

The other team members shall have experience in advertising, marketing, and promotion.

Project Duration

The project will be initiated on or about September 2010 and will continue until about March 2011

Key Deliverables

A preliminary scheduled of task due dates is shown below. Detailed schedule of reporting requirements will be established during contract negotiations.

Task	Deliverable	Due Date (after contract signing)	ESCOM Review and Comment
Task 1	Memo on consumer preferences and market barriers	2 weeks	1 week
Task 2	Review of international experience with CFL program marketing approaches and recommendations for Malawi	4 weeks	2 weeks
Task 3	Marketing and Promotion strategy and design of materials	8 weeks	1 week
Task 4	Report on implementation marketing and promotion	20 weeks	2 weeks
Task 5	Final Report	28 weeks	2 weeks

9.6 Terms of Reference for Monitoring and Evaluation Consultancy

Background

The Government of Malawi, facing a gap between the supply and demand for electricity, is embarking upon an energy efficiency program. A key element of this program is the bulk procurement and distribution of Compact Fluorescent Lamps (CFL), also known as Energy Saver Lamps. The CFL Program will be launched and managed by ESCOM using funds provided by international agencies.

The CFL Program consists of the following major components:

- CFL Bulk Procurement
- CFL distribution and installation
- CFL Marketing and Promotion
- Monitoring and Evaluation

One of the most important supporting activities involves monitoring and evaluation. ESCOM wishes to establish a monitoring and evaluation (M&E) function to support effective program management and assess the performance and impact of the CFL Program. ESCOM thus invites interested companies ("M&E Consultants") to design and implement an M&E framework for the program with respect to energy and environmental benefits.

This document specifies the Terms of Reference for consulting services for the conduct of program monitoring and evaluation of impacts

Objectives of the Assignment

The goal of this assignment will be to both implement program monitoring & evaluation with regard to the CFL Program, while at the same time building capacity within ESCOM to conduct program monitoring & evaluation activities in the future.

Consultant Scope of Work

1. The M&E Consultant will provide technical assistance to ESCOM to plan, develop, and implement a monitoring & evaluation framework for the CFL program.

2. The M&E Consultant should work with ESCOM to integrate the M&E process and procedures within implementation of the CFL Program. The goal of the M&E activities is to assess the progress and achievements of the CFL Program and test key assumptions in program design. ESCOM will monitor the Program outputs using data collection tools developed by the M&E consultant and will be assisted by the M&E consultant in assembling and analyzing the monitoring results. The M&E consultant will work with ESCOM to enable capacity-building and rapid understanding and application of lessons learned during the course of Program operations.

3. The M&E Consultant will: conduct initial training for the ESCOM staff and management; review available data and information systems; develop an M&E work plan; develop and implement an ongoing monitoring system; and design and carry out evaluation of the CFL program.

Description of Consultant Tasks

It is envisioned that the consultant will perform 6 primary tasks.

- Task 1. Initial Training in Monitoring & Evaluation
- Task 2. Review Available Data and Information Systems
- Task 3. Develop an M&E Work Plan
- Task 4. Design and Implement Program Evaluation
- Task 5. Prepare Final M&E Report

Task 1: Training in Monitoring & Evaluation

The M&E Consultant's first task will be to carry out a training workshop on the principles and practice of program monitoring & evaluation, with particular emphasis on aspects of evaluating the impact and cost-effectiveness of the CFL program from a utility perspective. The purpose of this initial training will be to ensure that there is a broad understanding among ESCOM staff and management of the benefits of an M&E system, and how to design and implement such a system. It will also build a core of support for future M&E activities and facilitate the consultant's task of data collection, work plan development, etc.

Task 2. Review Available Data and Information Systems

The role of the M&E Consultant will be to review the data with the goal of identifying key data needed to support the M&E activities. A list of possible data to support M&E is listed is below.

- Design Report for the CFL Program
- ESCOM system, generation, tariffs, and load characteristics
- ESCOM's average and marginal costs of electricity production
- Emission co-efficient and externalities[1] for ESCOM generation sources
- Market and cost data for CFLs
- Results from consumer Surveys

The M&E Consultant will also carefully review the information systems in place to collect and analyze these data. These include how the data are collected, and by whom; how and where the data are stored; and who can practically access the data.

The M&E Consultant will prepare a brief report reviewing the findings of this task. The report should document the existing information systems for the CFL Program; list available data; identify data gaps; and make recommendations as to where and how data collection needs to be improved.

Task 3. Develop an M&E Work Plan

[1] Environmental or other impacts that are not captured in traditional financial analysis

The M&E Consultant will work with ESCOM to develop an M&E Work Plan to guide the work during the program implementation period. This will be a broad plan that will distinguish and clarify the role of monitoring vs. evaluation during and after program implementation. It should describe all activities to be carried out, timing and sequence, and how the results of both the monitoring and evaluation activities will be used by ESCOM management.

The work plan should be written in a concise and practical manner and should clearly specify timing and responsibility for tasks – for example, tasks to be performed by the M&E Consultant, by ESCOM, by the lighting retailers, etc. The M&E Plan should include all program monitoring sheets that require to be completed by the relevant agencies.

Task 4. Design and Implement Program Evaluations

The M&E Consultant will also design and implement a system for evaluating the CFL program. The system will build on and be consistent with the M&E Plan developed in Task 3. While the monitoring is an ongoing process for tracking program progress and early identification of problems; evaluation is designed as a more comprehensive process to assess both qualitative and quantitative aspects of program operations and impact. .

The program evaluation will provide the technical basis for assessing the overall program performance. The evaluation methodology should be designed to be comprehensive and to assess both the *process* of the program (how well all elements of program operation worked, including customer acceptance) and the program *impact* (market impacts, energy savings and avoided peak demand, etc.). The evaluations should include a range of data collection techniques, to be proposed by the Consultant. These techniques should be adequate to provide a firm basis for making conclusions about program efficiency and effectiveness. Of particular impact to ESCOM will be the evaluation of cost-effectiveness and the documentation of *net financial benefits* due to reduced operational costs from reductions in energy use and peak demand.

The detailed evaluation design should include the following:

- objectives of the evaluation;
- data to be collected;
- methods used for data collection;
- sample size for each type of data collected; and
- locations and means of data collection;

The M&E Consultant will carry out the final evaluation of the CFL program, with assistance from ESCOM. The goal should be to implement the evaluation as on-the-job training exercise.

Task 5. Prepare Final M&E Report

The M&E Consultant will prepare a final report, documenting all activities conducted, results achieved and lessons learned.

List of Key Deliverables

The key deliverables are listed below:

Task(s)	Deliverable
Task 1	Training materials for initial M&E training for ESCOM staff
Task 2	Review of available data and information systems
Task 3	M&E work plan for the CFL Program
Task 4	Evaluation Report for the CFL Program
Task 5	Final report on M&E activities

Monitoring & Evaluation Consultancy -- Team Requirements and Functions

The Team Leader will be responsible for delivery of all Tasks and Deliverables set out in this TOR. Throughout assignment, the Team Leader will Report to ESCOM as well as interacting extensively with specific agencies.

The Team Leader will be responsible for the work of each team member and for ensuring quality services being provided by the team. Based on the results of each Task and Phase, the Team Leader may be required to modify the composition of the team to ensure that the objectives of the TOR are met.

Qualifications

The Team Leader will have at the minimum:

a) At least 7 to 10 years experience in the energy field, with a primary emphasis on DSM and significant experience in planning and evaluation of DSM programs. It is expected that consulting assignments would have been undertaken in developing countries, preferably in Africa or Asia. Broad experience in program monitoring and evaluation is required. Experience in training and capacity building in developing countries is required. Experience with developing and implementing advanced information systems for M&E is preferred

b) A Bachelor's degree in engineering, economics or in one of the social sciences; and

The experience of team members should include market and survey research, data collection and processing, program monitoring, program evaluation, statistical analysis, and training and capacity-building with implementing agencies. In addition, the team members should have in-depth

experience in their particular areas of expertise and developing country experience, preferably in Africa or Asia.

Schedule and Reporting Requirements

The duration of the assignment is expected to be around 9 months.

The consultant should propose a schedule for deliverables and reporting requirements. A detailed schedule of reporting requirements will be agreed during contract negotiations.

9.7 Baseline and Consumer Awareness Survey Form

Interview Code: _____ Interviewer: _____

Date/Time of Interview: _____

COMPACT FLUORESCENT LIGHTING DISTRIBUTION PROGRAM

BASELINE CUSTOMER SURVEY

CUSTOMER DETAILS

Customer Name	
Address	
Province	
Electricity Supplier	
Utility Account No.	
Ownership Status	Owner / Tenant / Other
Average Monthly Electricity Cost (MWK)	

1. LAMP HOURS OF OPERATION AND BASELINE PENETRATION

Lamp	Location	Type of Lamp[2] (IB / CFL / FTL/ O)	Type of Fitting[3] (S / P / O)	Lamp Wattage	Average use (Hours / day)	Working Condition (Yes / No)
1.1	Living Room					
1.2						
1.3						
1.4						
1.5						
2.1	Dining / Kitchen					
2.2						
2.3						
2.4						
2.5						
3.1	Bedrooms					
3.2						
3.3						

[2] Incandescent Bulb (IB), Compact Fluorescent Lamp (CFL), Fluorescent Tube Light (FTL), Other (O).

[3] Screw (S), Pin (P), Other (O)

3.4						
3.5						
4.1	Bathrooms & Other					
4.2						
4.3						
4.4						
4.5						

Summary

Total No: of Light Sockets	
Total No: of IBs	
Total No: of CFLs	
Most Used Lamp	
Location	
Lamp Type	
Average Use/day	

2. CFL AWARENESS AND LAMP PURCHASE HABITS

Q 2-1 Have you heard about energy saving Compact Fluorescent Lamps (CFLs)?

Yes	1	go to	Q 2-2
No	2	go to	Q 2-6

Q 2-2 Where did you first hear about CFLs?

Radio / TV advertisements	1
Newspapers	2
Retail Stores	3
Billboards	4
Other (specify)	5

Q 2-3 Do you regularly purchase CFLs?

Yes	1	go to	Q 2-4
No	2	go to	Q 2-5

Q 2-4 What are the main reasons for regularly purchasing CFLs?

Save Electricity Costs	1
Better light quality	2
They look good	3
Recommendation from Others	4
Other (specify)	5

Q 2-5	What are the main reasons for NOT regularly purchasing CFLs?	
	High Cost	1
	Not suitable for fittings	2
	Low light quality	3
	Other (specify)	4
Q 2-6	Would you be willing to buy an energy saving CFL that is more expensive than an Incandescent Bulb?	
	Yes ……..	1
	No ……	2
Q 2-7	How much energy do you think you can save by using a CFL compared to an Incandescent Bulb?	
	20%	1
	40%	2
	60%	3
	80%	4
Q 2-8	How many times do you think a good CFL will last compared to an Incandescent Bulb?	
	2 times	1
	3 times	2
	4 times	3
	6 times	4
Q 2-9	What type of lamp did you last purchase?	
	Incandescent Bulb (IB)	1
	Compact Fluorescent Lamp (CFL)	2
	Fluorescent Tube Light (FTL)	3
Q 2-10	Where did you purchase it?	
	Local Grocery Store	1
	Hardware store	2
	Other (specify)	3
Q 2-11	What was the cost of lamp?	
	< 75 MK	1
	75 – 200 MK	2
	200 – 400 MK	3
	> 400 MK	4

9.8 Post Installation Survey Form

Interview Code: _____

Interviewer: _____

Date/Time of Interview: _____

COMPACT FLUORESCENT LIGHTING PROGRAM

CUSTOMER SURVEY

Customer Details

Customer Name						
Address						
Province						
Utility Account No.						
Customer Code *(circle)*	Pre-Paid	1	Post-Paid	2	General Services	3

Introduction

My name is…….. and I am from …….. and I am conducting a survey on behalf of ESCOM on a CFL Lighting program.

Overview of the survey

ESCOM introduced a Compact Fluorescent Lighting (CFL) Program in 2010 to assist customers to save money on their electricity bills. This program was implemented by ESCOM, subcontractors and lighting retailers.

We are currently doing an evaluation of the program to see if it could be improved to help more customers benefit from the program. I would appreciate your assistance in answering a few questions about the program.

During the interview I will be taking notes but when we analyse the results all the customers participating in the survey will remain anonymous.

1. Program Participation

I'd like to begin our survey by finding out if you participated in the program.

ESCOM introduced a CFL Program in 2010 for all customers. The residential customer, small enterprises and public buildings were eligible for free CFLs directly installed in the premises. Other customer had the option of purchasing CFL at discounted prices from ESCOM or electrical retailers.

Q 1-1	Have you ever purchased and used a CFL?			
	Yes	1	go to	
	No	2	go to	Q 4-1
Q 1-2	Did you receive or purchase CFLs under this program?			
	Yes	1	Go to	Q 2-1
	No	2	Go to	Q 3-1

2. PROGRAM PARTICIPATING USERS

I would now like to ask you more details about your participation in this program

Q 2-1	Have you purchased any CFLs directly from the retailers before this program was introduced?			
	Yes …… …….	1		
	No ……....	2		
Q 2-2	How many lamps did you purchase or receive under the ESCOM scheme?			
	One …… …….	1		
	Two ……....	2		
	Three……....	3		
	Four……....	4		
	Five …….	5		
	Six …….....	6		
	Other (specify – how many)……..			
Q 2-3	Where were the lamp(s) installed?		How many	
	Veranda / Lounge/Dining area ……	1		
	Kitchen …….	2		
	Bedrooms …….	3		
	Outside (security lights)…….	4		
	Other (specify) …….	5		
Q 2-4	Were the CFLs used as replacement of existing incandescent lamps or in new installations?			
	Replacement of Incandescent lamps	1	1	Q 2-5
	New fittings ……..	2	2	Q 2-6
	Both …….	3	3	Q 2-5
Q 2-5	What was the wattage of the incandescent lamps replaced?		How many	
	40W …….	1		
	60W …….	2		
	75W …….	3		
	100W ……....	4		
	Other (specify) …….			
Q 2-6	Are the lamps still operating?		How many	
	Yes …….	1		Q 2-10

	No ……..	2		Q 2-7
Q 2-7	After how long did the lamp(s) fail?		How many	
	Within 3 months ……	1		
	Between 3 and 6 months ……..	2		
	After 6 months ……..	3		
Q 2-8	Were the lamps replaced by ESCOM during the warranty period?			
	Yes ……..	1		Q 2-10
	No ……..	2		Q 2-9
Q 2-9	Why did you not use the warranty?			
	Reason:			
Q 2-10	On an average, how many hours a day the lamps are in use?		How many	
	Less than 3 hours	1		
	Between 3 - 6 hours	2		
	More than 6 hours	3		
Q 2-11	Where did you hear about the CFL Program?			
	Newspaper ……	1		
	ESCOM program mail-out ……..	2		
	Radio ……..	3		
	ESCOM Brochures/ Flyers	4		
	Other program participants	5		
	Other (specify) ……	6		
Q 2-12	Were the advertisements / ESCOM literature easy to understand?			
	Yes ……..	1	go to	Q 2-14
	No ……..	2	go to	Q 2-13
Q 2- 13	Why was it difficult to understand?			
	Reasons:			
Q 2-14	Why did you decide to participate in the CFL Program? *Multiple responses allowed*			
	Given Free by ESCOM ……..	1		
	Discounted Price ……	2		
	Manufacturers Warranty ……..	3		

	Savings Potential ……..	4		
	Other (specify) ……..	5		

Q 2-15 Are you satisfied with the performance of the CFLs?

Yes ……..	1	go to	Q 2-17
No ……..	2	go to	Q 2-16

Q 2- 16 What aspects were you not satisfied with?

Quality of light ……..	1
Looks ……..	2
Level of saving ……..	3
Other (specify) ……..	4

Q 2-17 How do you rate the following aspects of the program?

	Good	Fair	Unsatisfactory
ESCOM installation process ……..			
Choice of CFLs ……..			
Location of ESCOM Bill Payment Centers ……..			
Price of CFLs ……..			
Length of warranty ……..			

Q 2- 18 Do you have any suggestions for improving the program?

Suggestions:
Q 2-19 What is your current average monthly electricity bill? (MK)
Q 2-20 What was your average monthly electricity bill before installing CFLs? (MK)
Q 2-21 How many CFLs you have purchased outside ESCOM program? *(enter zero if none)*

THANK YOU VERY MUCH FOR YOUR COOPERATION

3. NON-PARTICIPATING USERS

I would now like to ask you more details about your use of CFLs

Q 3-1	Please provide the number, wattage and average daily use of CFLs installed in your home?	No	Watts	Hours of Use
	Veranda / Lounge/Dining area ……			
	Kitchen ……			
	Bedrooms ……			
	Outside ……			
	Other (specify) ……			
Q 3-2	What were the main reasons for using CFLs? *(Multiple allowed)*			
	Save electricity costs	1		
	Better light quality	2		
	They look good	3		
	They are fashionable	4		
	Recommendation of friends and acquaintances	5		
	Other (Specify) ……....	6		
Q 3-3	Where did you purchase the lamps from?			
	Local shop	1		
	Shop in nearby town	2		
	From city	3		
	Other (specify) ……	4		
Q 3-4	Were the CFLs used as replacement of existing incandescent lamps or in new installations?			
	Replacement of Incandescent lamps	1		Q 3-5
	New fittings ……..	2		Q 3-6
	Both ……	3		Q 3-5
Q 3-5	What was generally the wattage of the incandescent lamps replaced?			
	40W ……	1		
	60W ……	2		
	75W ……	3		
	100W ……..	4		
Q 3-6	Are the lamps still operating?			
	Yes ……	1	go to	Q 3-8
	No ……..	2		
Q 3-7	After how long did the lamp(s) fail?			

	Within 3 months ……	1		
	Between 3 and 6 months ……..	2		
	Between 6 and 9 months ……..	3		
	After 9 months……	4		
Q 3-8	Are you satisfied with the performance of the CFLs?			
	Yes ……..	1	go to	Q 3-10
	No ……..	2	go to	Q 3-9
Q 3-9	What aspects were you not satisfied with?			
	Quality of light ……..	1		
	Looks ……..	2		
	Level of saving ……..	3		
	Other (specify) ……..	4		
Q 3-10	Are you aware of the CFL Program sponsored by ESCOM?			
	Yes ……..	1	go to	Q 3-11
	No ……..	2	go to	Q 3-12
Q 3-11	What do you consider to be the main reasons why you have not received or purchased CFLs under the ESCOM program? *Do not prompt*, *multiple responses allowed*			
	Procedures for obtaining CFLs ……	1		
	Choice CFL Brand ……..	2		
	Cost……..	3		
	Looks……..	4		
	Not suitable for fittings……..	5		
	Quality of light……..	6		
	Do not believe the savings ……..	7		
	Do not believe lamp life……..	8		
	Bad experience in using CFLs ……	9		
	Other (specify)……..	10		
	……			
Q 3-12	Do you recall ever receiving information about ESCOM's CFL program?			
	Yes ……..	1		
	No ……..	2	go to	End Survey
Q 3-13	Were the advertisements / ESCOM literature easy to understand?			
	Yes ……..	1		
	No ……..	2		
Q 3-14	Why was it difficult to understand?			

Reasons:

4. NON – USERS

Q 4-1 What is your average monthly electricity bill in MK?

Q 4-2 Please provide the number, wattage and average daily use of lighting lamps installed in your home?

	No	Watts	Hours of Us
Veranda / Lounge/Dining area ……			
Kitchen ……..			
Bedrooms ……..			
Outside ……..			
Other (specify) ……..			
Veranda / Lounge/Dining area ……			

Q 4-3 Are you aware that CFLs consume far less energy than normal incandescent lamps?

Yes ……..	1		
No ……..	2		

Q 4-4 Are you aware that use of CFLs can reduce your electricity bill?

Yes ……..	1		
No ……..	2	go to	Q 4-4

Q 4-5 What are the main reasons for not using the CFLs?

They are costly	1
Poor Quality	2
Bad experience	3
They don't look good	4
The light quality is not good	5
Can not be bothered, too much hassle	6
Other (specify) ……..	7

Q 4-6 Are you aware of the CFL Program sponsored by ESCOM?

Yes ……..	1	go to	Q 4-5
No ……..	2	go to	Q 4-6

Q 4-7 What do you consider to be the main reasons why you have not received or purchased CFLs under the ESCOM program? *Do not prompt*, *multiple responses allowed*

Procedures for obtaining CFLs ……	1
Choice CFL Brand ……..	2

	Cost……..	3
	Looks……	4
	Not suitable for fittings……	5
	Quality of light……	6
	Do not believe the savings ……..	7
	Do not believe lamp life……..	8
	Bad experience in using CFLs …….	9
	Other (specify)……..	10

……

Q 4-8 Do you recall ever receiving information about ESCOM's CFL program?

	Yes ……..	1
	No ……	2

Q 4-9 Were the advertisements / ESCOM literature easy to understand?

	Yes ……..	1
	No ……	2

Q 4-10 Why was it difficult to understand?

Reasons:

THANK YOU VERY MUCH FOR YOUR COOPERATION

9.9 Program Benefit Cost Analysis

Assumptions

Based on discussions with ESCOM and information from the customer surveys, the following assumptions were used in the calculations:

Parameter	Assumption	Rationale / Comments
Wattage of IBs replaced	40 W (15.5%); 60W (57.3%); 75W (4.9 %) and 100W (22.2%)	Information from last customer survey (1995).
Wattage of CFLs	15W – to replace IBs <60W 20W – to replace IBs > 60 W	Based on equivalent lumens output in order to ensure same or better light quality
Usage per day	3 hours average	International experience in the absence of baseline survey
Coincidence Factor	60%	Assumes on average 60% of CFLs are operating at any given time during the system peak period.
Avoided Capacity Cost	$2,000 per kW	Estimated cost of next planned power plant – provided by ESCOM
Avoided Cost of Energy	1.35 c/kWh	Estimated generation costs of next planned power plant – provided by ESCOM
Average energy costs (tariff)	Residential – 3.7 c/kWh Other Customers – 7.5 c/kWh	Provided by ESCOM
Cost of CFLs	$1.50	Based on estimated budget of $3M for 2M CFLs

Case 1: 15W and 20W CFL Installation in Residential Sector

ESCOM (Malawi) CFL Program - Energy, Peak Demand and Cost Savings
Option : 15W and 20W CFL : Residential Customers

Inputs	Units	1	2	3	4	
Type of Replaced Lamp		IB	IB	IB	IB	
Wattage of replaced Lamp	W	40	60	75	100	
No: of Lamps Replaced	#	159,328	588,287	50,775	227,611	1,026,000
Wattage of CFL	Watts	15	15	20	20	
Power factor of Replaced Lamp	%	100%	100%	100%	100%	
Usage per day	Hours	3.0	3.0	3.0	3.0	
CFL Lifetime	Hours	10,000	10,000	10,000	10,000	
Power Factor of CFLs	%	50%	50%	50%	50%	
Coincidence Factor	%	60%	60%	60%	60%	
Leakage Factor	%	0%	0%	0%	0%	
Network Losses	%	21%	21%	21%	21%	
Program Cost per CFL - Installed	$/Lamp	0.00	0.00	0.00	0.00	
Energy Cost per kWh	c/kWh	3.7	3.7	3.7	3.7	
Avoided Capacity Cost per kW	$/kW	2,000	2,000	2,000	2,000	
Annual Cost of Capital	%	8.5%	8.5%	8.5%	8.5%	
Results						Total
Savings at Customer Level	Watts	25	45	55	80	
Peak Savings per Unit	Watts	25	45	55	80	
Annual Energy Savings - per unit	kWh	27.4	49.3	60.2	87.6	
Lifetime Savings - per unit	kWh	250.0	450.0	550.0	800.0	
Peak Savings - Network Level	MW	3.0	20.1	2.1	13.8	39.1
Total Energy Savings - Annual	GWH/yr	5.5	36.7	3.9	25.2	71.3
Total Energy Savings - Equip. Lifetime	GWH	50.4	335.1	35.3	230.5	651.4
Energy Cost Savings - Annual	Million $	0.2	1.4	0.1	0.9	2.7
Avoided Capacity Costs	Million $	6.1	40.2	4.2	27.7	78.2
Capacity Cost Savings - Annualized	Million $	0.5	3.4	0.4	2.4	6.6
Annual Savings - Energy & Capacity	Million $	0.7	4.8	0.5	3.3	9.3
Lifetime Savings - Energy & Capacity	Million $	6.6	43.7	4.6	30.1	85.0
ESCOM Avoided Marginal Losses	Million $	0.19	1.28	0.14	0.88	2.5
Customer Benefits						
CFL Cost	Million $	0.00	0.00	0.00	0.00	0.00
Annual Cost Saving - per unit	$	1.02	1.84	2.25	3.28	
Annual Cost Saving - per unit	MK	154	276	338	491	
Payback to Customer	Months	0.0	0.0	0.0	0.0	
Lifetime Cost Savings - per unit	$	9.4	16.8	20.6	29.9	
Lifetime Cost Savings - per unit	MK	1,403	2,525	3,086	4,488	
Benefit / Cost ratio						
Overall Benefits						
Total Annual Cost Savings	$	163,124	1,084,145	114,366	745,708	2,107,342
	MK	24,468,544	162,621,707	17,154,869	111,856,201	316,101,321
Total Cost of CFLs	$	-	-	-	-	0
	MK	-	-	-	-	-
Overall payback period	Months	-	-	-	-	-
Life-time Cost savings	$	1,489,713	9,900,865	1,044,436	6,810,119	19,245,134
	MK	223,457,022	1,485,129,747	156,665,473	1,021,517,816	2,886,770,058
Overall Benefit / Cost Ratio						

Total CFLs 1,026,000

IBs Replaced		
40W	15.5%	159,328
60W	57.3%	588,287
75W	4.9%	50,775
100W	22.2%	227,611
		1,026,000
Total	100%	

Exchange rate 1 US$ 150 MK

Avoided Cost of Energy 1.35 c/kWh

ESCOM Benefits		US$
MWh/yr	71,324	962,875
MW	39.1	78,163,408
Annualized		6,643,890
Red Supply Costs		85,770,173
Cust Bill Svaings		2,667,522
Net Benefit		83,102,651
Program Costs		-
Incentives		-
CER Revenue		
CFL Sales Revenue		
Total Costs		-
B/C		

Case 2: 15W and 20W CFL Installation in Small Enterprises and Public Buildings

ESCOM (Malawi) CFL Program - Energy, Peak Demand and Cost Savings
Option : 15W and 20W CFL : Small Enterprises and Public Sector

Inputs	Units	1	2	3	4	
Type of Replaced Lamp		IB	IB	IB	IB	
Wattage of replaced Lamp	W	40	60	75	100	
No: of Lamps Replaced	#	42,549	157,106	13,560	60,785	274,000
Wattage of CFL	Watts	15	15	20	20	
Power factor of Replaced Lamp	%	100%	100%	100%	100%	
Usage per day	Hours	3.0	3.0	3.0	3.0	
CFL Lifetime	Hours	10,000	10,000	10,000	10,000	
Power Factor of CFLs	%	50%	50%	50%	50%	
Coincidence Factor	%	60%	60%	60%	60%	
Leakage Factor	%	0%	0%	0%	0%	
Network Losses	%	21%	21%	21%	21%	
Program Cost per CFL - Installed	$/Lamp	0.00	0.00	0.00	0.00	
Energy Cost per kWh	c/kWh	7.5	7.5	7.5	7.5	
Avoided Capacity Cost per kW	$/kW	2,000	2,000	2,000	2,000	
Annual Cost of Capital	%	8.5%	8.5%	8.5%	8.5%	
Results						Total
Savings at Customer Level	Watts	25	45	55	80	
Peak Savings per Unit	Watts	25	45	55	80	
Annual Energy Savings - per unit	kWh	27.4	49.3	60.2	87.6	
Lifetime Savings - per unit	kWh	250.0	450.0	550.0	800.0	
Peak Savings - Network Level	MW	0.8	5.4	0.6	3.7	10.4
Total Energy Savings - Annual	GWH/yr	1.5	9.8	1.0	6.7	19.0
Total Energy Savings - Equip. Lifetime	GWH	13.5	89.5	9.4	61.6	174.0
Energy Cost Savings - Annual	Million $	0.1	0.7	0.1	0.5	1.4
Avoided Capacity Costs	Million $	1.6	10.7	1.1	7.4	20.9
Capacity Cost Savings - Annualized	Million $	0.1	0.9	0.1	0.6	1.8
Annual Savings - Energy & Capacity	Million $	0.2	1.7	0.2	1.1	3.2
Lifetime Savings - Energy & Capacity	Million $	2.3	15.1	1.6	10.4	29.3
ESCOM Avoided Marginal Losses	Million $	0.05	0.34	0.04	0.24	0.7
Customer Benefits						
CFL Cost	Million $	0.00	0.00	0.00	0.00	0.00
Annual Cost Saving - per unit	$	2.06	3.72	4.54	6.61	
Annual Cost Saving - per unit	MK	310	557	681	991	
Payback to Customer	Months	0.0	0.0	0.0	0.0	
Lifetime Cost Savings - per unit	$	18.9	33.9	41.5	60.3	
Lifetime Cost Savings - per unit	MK	2,828	5,090	6,221	9,048	
Benefit / Cost ratio						
Overall Benefits						
Total Annual Cost Savings	$	87,825	583,701	61,574	401,487	1,134,588
	MK	13,173,800	87,555,103	9,236,137	60,223,087	170,188,126
Total Cost of CFLs	$	-	-	-	-	0
	MK	-	-	-	-	-
Overall payback period	Months	-	-	-	-	-
Life-time Cost savings	$	802,058	5,330,600	562,322	3,666,550	10,361,530
	MK	120,308,677	799,589,980	84,348,282	549,982,526	1,554,229,464
Overall Benefit / Cost Ratio						

Total CFLs 274,000

IBs Replaced		
40W	15.5%	42,549
60W	57.3%	157,106
75W	4.9%	13,560
100W	22.2%	60,785
		274,000
Total	100%	

Exchange rate 1 US$ 150 MK

Avoided Cost of Energy 1.35 c/kWh

ESCOM Benefits		US$
MWh/yr	19,048	257,142
MW	10.4	20,874,048
Annualized		1,774,294
Red Supply Costs		22,905,485
Cust Bill Svaings		1,436,187
Net Benefit		21,469,298
Program Costs		-
PC Incentives		-
CER Revenue		
CFL Sales Revenue		
Total Costs		-
B/C		

Case 3: 15W and 20W CFL Sales for the Private Sector

ESCOM (Malawi) CFL Program - Energy, Peak Demand and Cost Savings
Option : 15W and 20W CFL : Private Sector

Inputs	Units	1	2	3	4	
Type of Replaced Lamp		IB	IB	IB	IB	
Wattage of replaced Lamp	W	40	60	75	100	
No: of Lamps Replaced	#	108,703	401,365	34,642	155,290	700,000
Wattage of CFL	Watts	15	15	20	20	
Power factor of Replaced Lamp	%	100%	100%	100%	100%	
Usage per day	Hours	3.0	3.0	3.0	3.0	
CFL Lifetime	Hours	10,000	10,000	10,000	10,000	
Power Factor of CFLs	%	50%	50%	50%	50%	
Coincidence Factor	%	60%	60%	60%	60%	
Leakage Factor	%	0%	0%	0%	0%	
Network Losses	%	21%	21%	21%	21%	
Program Cost per CFL - Installed	$/Lamp	2.00	2.00	2.00	2.00	
Energy Cost per kWh	c/kWh	7.5	7.5	7.5	7.5	
Avoided Capacity Cost per kW	$/kW	2,000	2,000	2,000	2,000	
Annual Cost of Capital	%	8.5%	8.5%	8.5%	8.5%	
Results						Total
Savings at Customer Level	Watts	25	45	55	80	
Peak Savings per Unit	Watts	25	45	55	80	
Annual Energy Savings - per unit	kWh	27.4	49.3	60.2	87.6	
Lifetime Savings - per unit	kWh	250.0	450.0	550.0	800.0	
Peak Savings - Network Level	MW	2.1	13.7	1.4	9.4	26.7
Total Energy Savings - Annual	GWH/yr	3.8	25.0	2.6	17.2	48.7
Total Energy Savings - Equip. Lifetime	GWH	34.4	228.6	24.1	157.3	444.4
Energy Cost Savings - Annual	Million $	0.3	1.9	0.2	1.3	3.7
Avoided Capacity Costs	Million $	4.1	27.4	2.9	18.9	53.3
Capacity Cost Savings - Annualized	Million $	0.4	2.3	0.2	1.6	4.5
Annual Savings - Energy & Capacity	Million $	0.6	4.2	0.4	2.9	8.2
Lifetime Savings - Energy & Capacity	Million $	5.8	38.5	4.1	26.5	74.9
ESCOM Avoided Marginal Losses	Million $	0.13	0.88	0.09	0.60	1.7
Customer Benefits						
CFL Cost	Million $	0.22	0.80	0.07	0.31	1.40
Annual Cost Saving - per unit	$	2.06	3.72	4.54	6.61	
Annual Cost Saving - per unit	MK	310	557	681	991	
Payback to Customer	Months	11.6	6.5	5.3	3.6	
Lifetime Cost Savings - per unit	$	18.9	33.9	41.5	60.3	
Lifetime Cost Savings - per unit	MK	2,828	5,090	6,221	9,048	
Benefit / Cost ratio		9.4	17.0	20.7	30.2	
Overall Benefits						
Total Annual Cost Savings	$	224,371	1,491,206	157,306	1,025,697	2,898,581
	MK	33,655,694	223,680,919	23,595,970	153,854,601	434,787,184
Total Cost of CFLs	$	217,406	802,730	69,283	310,580	1,400,000
	MK	32,610,922	120,409,556	10,392,491	46,587,031	210,000,000
Overall payback period	Months	11.63	6.46	5.29	3.63	5.80
Life-time Cost savings	$	2,049,053	13,618,321	1,436,589	9,367,099	26,471,061
	MK	307,357,935	2,042,748,123	215,488,311	1,405,064,846	3,970,659,215
Overall Benefit / Cost Ratio						18.91

Total CFLs 700,000

IBs Replaced		
40W	15.5%	108,703
60W	57.3%	401,365
75W	4.9%	34,642
100W	22.2%	155,290
		700,000
Total	100%	

66.455

Exchange rate 1 US$ 150 MK

Avoided Cost of Energy 1.35 c/kWh

76.2
139.0
1,269.7

ESCOM Benefits		US$	Overall Benefits US$
MWh/yr	48,662	656,933	1,876,950
MW	26.7	53,327,861	152,365,317
Annualized		4,532,868	12,951,052
Red Supply Costs		58,517,662	167,193,320
Cust Bill Svaings		3,669,090	7,772,799
Net Benefit		54,848,572	159,420,521
			-
Program Costs		3,000,000	3,000,000
PC Incentives		-	-
CER Revenue			-
CFL Sales Revenue		1,050,000	1,050,000
Total Costs		1,950,000	1,950,000
B/C			81.75

Financial Analysis – Customer Perspective

	CFLs	Savings (Gwh/yr)	Years	Tariff (c/kWh)	Savings ($M/yr))
Residential	1,026,000	71.30	9.13	3.74	2.67
Small Enterprises & Public Sector	274,000	19.00	9.13	7.54	1.43
Private sector	700,000	48.70	9.13	7.54	3.67
Total	2,000,000	139.00			7.77
Discount Rate	8.5%				

	0 2011	1 2012	2 2013	3 2014	4 2015	5 2016	6 2017	7 2018	8 2019	9 2020	10 2021
Annual Energy Savings ($M/year)		4.66	7.77	7.77	7.77	7.77	7.77	7.77	7.77	7.77	3.71
Discount Factor	1.0000	0.9217	0.8495	0.7829	0.7216	0.6650	0.6129	0.5649	0.5207	0.4799	0.4423
Discounted Present Value	-	4.30	6.60	6.08	5.61	5.17	4.76	4.39	4.05	3.73	1.64
Net Present Value ($M)	44.69										

Assumptions

1. Timetable of distribution 0 year 60%
   1st year 40%

Financial Analysis – ESCOM Perspective

	Rate	Savings	Savings ($M/yr))
Avoided Energy Costs (GWh)	1.35 c/kWh	139.00	1.88
Avoided Capacity Costs (MW)	2,000 $/kW	76.20	152.40
Avoided Cost of Capital	8.5%		12.95
Project Life (years)	9.13		
Red Supply Costs			167.19
Cust Bill Savings			7.77
Net Benefit			159.42
Revenue from CFL Sales			1.05
Discount rate	8.5%		

	0 2011	1 2012	2 2013	3 2014	4 2015	5 2016	6 2017	7 2018	8 2019	9 2020	10 2021
Avoided Energy Costs ($M)	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	1.88	0.24	-
Avoided Capacity Costs ($M)	152.40	0									
Avoided Cost of Capital ($M)	12.95	12.44	11.92	11.40	10.88	10.36	9.85	9.33	8.81	8.29	7.77
Cust Bill Savings		(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(7.77)	(1.01)
Investment Cost ($M)	(3.00)	-									
CFL Sales Revenue	1.05										
Total	165.28	6.54	6.02	5.50	4.99	4.47	3.95	3.43	2.91	0.76	6.76
Discount Factor	1.0000	0.9217	0.8495	0.7829	0.7216	0.6650	0.6129	0.5649	0.5207	0.4799	0.4423
Discounted Present Value ($M)	165.28	6.03	5.12	4.31	3.60	2.97	2.42	1.94	1.52	0.37	2.99
Net Present Value ($M)	196.54										

Assumptions

1. Timetable of distribution	0 year	100%
	1st year	0%
2. Total Investment Cost	$ M	3
3. Tenure of loan avoided	years	25

Sensitivity Analysis	
Discount Rate	NPV ($M)
8.50%	198.5
9.00%	197.9
10.00%	196.8
8.00%	199.1
7.50%	199.8
7.00%	200.4