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Regional Report on Efficient Lighting in Sub-Saharan African Countries

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Executive summary and recommendations for policy makers

This report presents information on the electricity sector and efficient lighting activities in the following 37 sub-Saharan Africa countries:

- Angola
- Benin
- Burkina Faso
- Cameroon
- Cape Verde
- Central African Republic
- Chad
- Côte d'Ivoire
- Democratic Republic of the Congo
- Ethiopia
- Gabon
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Kenya
- Lesotho
- Madagascar
- Malawi
- Mauritania
- Mauritius
- Mozambique
- Namibia
- Niger
- Nigeria
- Rwanda
- Senegal
- Seychelles
- Sierra Leone
- South Africa
- Sudan
- Swaziland
- Tanzania
- Togo
- Uganda
- Zambia
- Zimbabwe

The report examines and assesses the lighting initiatives for each country. It also focuses on the successes and insights obtained by some of the pioneering countries that have initiated programs to phase out inefficient lighting and that have shared experiences with other countries within the region.

In order to better classify, compare and analyze findings of the study, the authors have grouped the sub-Saharan Africa countries into five regions: Eastern Africa, Central Africa, Northern Africa, Southern Africa, and Western Africa.

Improved energy efficiency by phasing out inefficient incandescent lamps and introducing efficient lighting is one of the easiest and most cost effective ways to address energy and climate change issues faced by the region. Activities aimed at phasing out inefficient lighting

technologies are still in the development stage in sub-Saharan Africa. Efforts to promote the adoption and sustained usage of efficient technologies need to be strengthened.

Estimates made by UNEP/GEF en.lighten initiative suggest that the transition to efficient lighting in sub-Saharan Africa would achieve significant economic and environmental impact:

- 14 TWh of energy saved annually
- 10.5M tons of CO_2 emissions avoided
- Peak load shaving and reduction of power outages

To ensure the most sustainable, effective and long term implementation for a transition to efficient lighting, en.lighten recommends that countries focus on an integrated policy approach rather than emphasizing only one aspect. Key elements include:

1) Minimum energy performance standards (MEPS)
2) Supporting policies and mechanisms
3) Monitoring, verification and enforcement
4) Environmentally sound management

This report will be shared with policy makers, regulators and other key stakeholders of the region to enable the identification of areas where the UNEP en.lighten initiative can provide solutions and support.

Some countries already have successful efficient lighting polices in place including fiscal incentives, such as tax incentives and import duties on energy efficient lighting equipment. However, sub-Saharan Africa countries should follow an integrated approach to develop standards, labeling schemes, raising public awareness and sound waste management. Some countries, such as Ghana, do have testing facilities. End-of- life approaches (collection and recycling of lamps) are not common in the region.

To determine how sub-Saharan Africa countries could sustainably and effectively phase out inefficient lighting, the report provides areas of discussion for policy makers and stakeholders such as:

- Regulations and standards from countries in which they are already established, such as existing labeling and testing facilities;
- Benefits from carbon markets for less advanced countries;
- Power pools to encourage the whole region to benefit from bulk procurement that could lower prices

The UNEP/GEF en.lighten initiative provides online resources and expert technical support for regions and countries to develop policies, strategies and concrete actions for the phase-out of inefficient lighting.

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Abbreviations

CAPP	Central Africa Power Pool
CDM	Clean Development Mechanism
CEET	Compagnie Energie Electrique du Togo
ECOWAS	Economic Community of West African States (also known as CEDEAO)
CFL	compact fluorescent lamp
EAPP	Eastern Africa Power Pool
ELI	Efficient Lighting Initiative
ESMAP	Energy Sector Management Assistance Program
g	gram
GEF	Global Environment Facility
GHG	greenhouse gas
GS VER	Gold Standard Voluntary Emission Reduction
GWh	gigawatt-hour (10^9 watt-hour)
HDI	Human Development Index
kt	kilotonnes, equal to 1,000 metric tons
kWh	kilowatt-hour
LDC	Least Developed Countries
LED	light emitting diode
M	million
mg	milligram
MEPS	minimum energy performance standards
MWh	megawatt-hour (10^6 watt-hour)
SADC	Southern African Development Community
SAPP	Southern African Power Pool
SEC	Swaziland Electricity Company
SENELEC	Société National d'Electricité du Sénégal
UEMOA	Union Economique et Monétaire Ouest-Africaine (West African Economic and Monetary Union)
UMEME	Ugandan Energy Distribution Network Company
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
WBG	World Bank Group
WAPP	West African Power Pool

1. Introduction

This report primarily focuses on lamps used for general service illumination in residential, public and commercial buildings. These include linear fluorescent lamps with omnidirectional output, although in some countries neon tubes are the dominant lighting technology. The report also addresses efficient lamps such as light emitting diode (LED) lamps and compact fluorescent lamps (CFLs). Results from a questionnaire distributed to countries to obtain accurate information are included in Appendix 1.

1.1. Sub-Saharan Africa

The sub-Saharan African region includes 33 of the 48 Least Developed Countries[1]. Although electricity tariffs in most sub-Saharan Africa countries have been kept at a minimum due to massive subsidies[2], the average tariff across the region is high (0.13 USD per kWh), almost 100% more than other parts of the developing world and almost as high as in OECD countries. Nevertheless, the electricity tariffs fail to recover the cost of production and distribution[3]. Therefore, electricity is a major drain on public finance, as each kWh distributed represents a gross financial loss. In Chad, for example, subsidies for electricity (primarily the purchase of fossil fuels) represent 55 million USD (20% of the annual government subsidies)[4].

Despite higher economic growth enjoyed in the past decade, access to electricity has not significantly increased. Many sub-Saharan African countries face regular and frequent blackouts due to insufficient generating capacity, especially at peak load; weak infrastructure; minimal expansion of generation and transmission facilities; unreliable supplies; and increasing costs of fossil fuels. This adversely affects productivity and regional economic growth. An increasingly common response to the energy crisis has been the short term lease of emergency power generators, which is not only expensive, but impacts the sustainable development of the region. In addition, the African electricity grids lack interconnections which would facilitate network management and have a positive impact on electricity distribution and availability.

Cooperation for establishing cross-border interconnection (see Appendix 2 for electrical grid maps for each region) and associated electricity exchange in Africa can be traced back to the 1950s. For many years, there have been sub-regional power pools in Africa:

- WAPP: West African Power Pool
- CAPP: Central Africa Power Pool
- EAPP: Eastern Africa Power Pool

[1] United Nations. List of least developed countries. Retrieved on 29 November 2012 from: http://www.un.org/esa/policy/devplan/profile/ldc_list.pdf

[2] Union of African Electricity Producers and Distributers (UPDEA) (2009). Comparative study of electricity tariffs used in Africa. Retrieved on 29 November 2012 from: http://www.updea-africa.org/updea/DocWord/TarifAng2010.pdf

[3] International Monetary Fund (IMF) (2008). Regional economic outlook: sub-Saharan Africa. Retrieved on 29 November 2012 from: http://www.imf.org/external/pubs/ft/reo/2008/afr/eng/sreo0408.pdf

[4] Interview with the Officers from Chad Ministry of Economy, Plan and Cooperation.

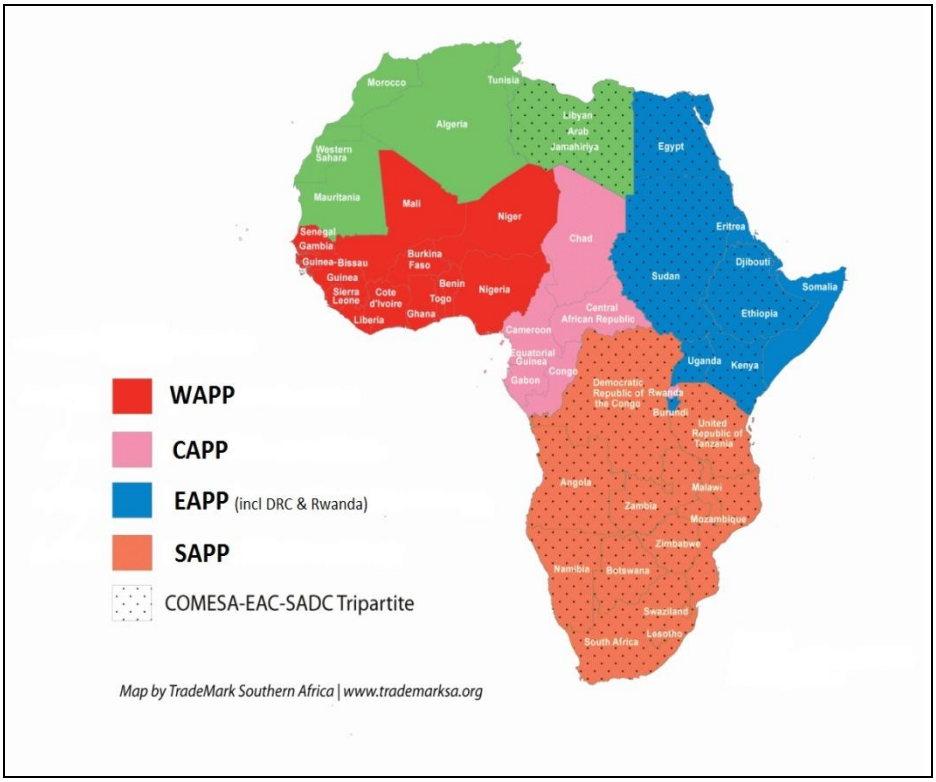
- SAPP: Southern African Power Pool

The power pools consist of countries and/or utilities with interconnected power systems that provide increased quality and reliability of electricity services; lower electricity production costs; reduced levels of required reserve capacity; and mutual support in times of emergency.

The security and reliability of electricity supply has been the driving force behind power system interconnection and the promotion of cross-border electricity trade. *Source: Adapted from Southern Africa Power Pool - 2012*

Figure 1 is a map of the regional power pools. It identifies the profile of power generation, and indicates the dependence on fossil fuels (diesel, gas and coal). According to World Bank Indicators, more than 57% of total electricity production is from coal sources in sub-Saharan Africa[5].

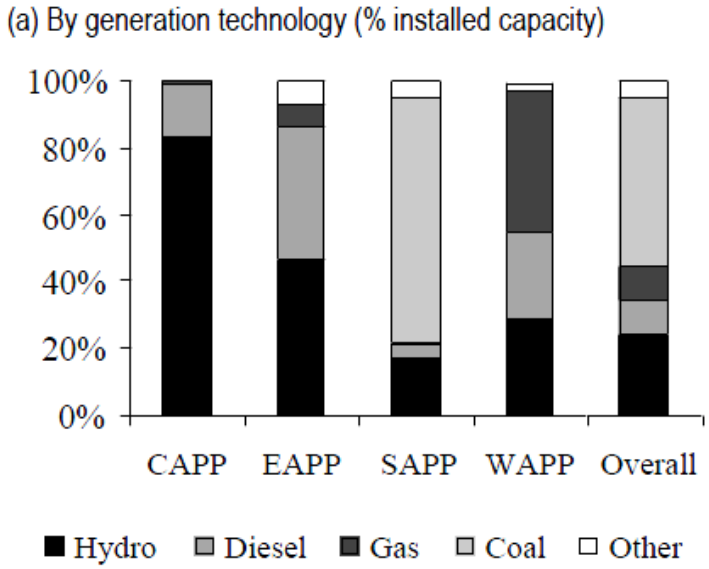
Figure 1. Map of African Power Pools



Source: Adapted from Southern Africa Power Pool - 2012

[5] Trading Economics (2010). Electricty production from coal sources in Sub-Saharan Africa. Retrieved on 29 November 2012 from: http://www.tradingeconomics.com/sub-saharan-africa/electricity-production-from-coal-sources-percent-of-total-wb-data.html

Figure 2. Profile of power generation assets in sub-Saharan Africa



Source: Platts and IEA - 2011

While the regional power pools have made progress in developing standard trade agreements, trade between countries continues to be minimal. As is shown in the Figure 3, the overall trading volume is relatively low. Most trade occurs within the SAPP, between South Africa and Mozambique, where South Africa re-exports most of the electricity that it imports from Mozambique back to country's aluminum smelter. [6]

Figure 3. Regional Trade in Electricity, 2005

[6] Eberhard, A., Rosnes, O., Shkaratan, M., & Vennemo, H. The World Bank (2011). Africa's power infrastructure. Retrieved on 29 November 2012 from: http://elibrary.worldbank.org/content/book/9780821384558

	Consumption (TWh)	Imports (TWh)	Exports (TWh)	Percentage electricity traded
CAPP	8.80	0.01	1.80	0.1
EAPP	13.41	0.28	0.18	2.1
SAPP	233.97	22.71	25.74	9.7
WAPP	28.63	1.63	2.04	5.7

Source: Eberhard and others 2008.
Note: CAPP = Central African Power Pool; EAPP = East African Power Pool; SAPP = Southern African Power Pool; WAPP = West African Power Pool; TWh = terawatt-hour.

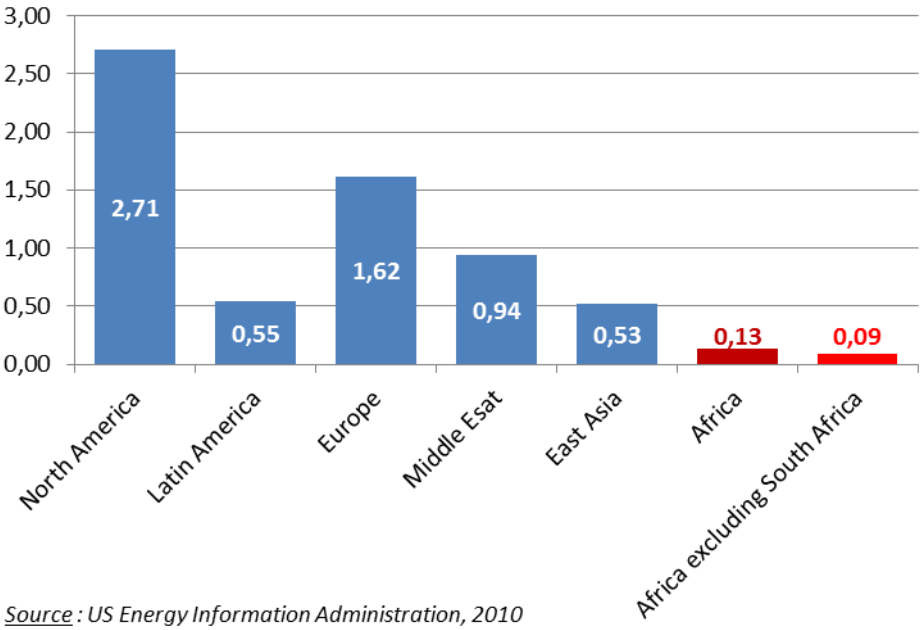
Source: Eberhard and the World Bank

2. Electricity situation – global and regional figures for energy consumption

On average, the electricity access rate is less than 31% in sub-Saharan Africa countries. The combined total generation capacity of sub-Saharan Africa is approximately 63 GW, comparable to that of Spain. If South Africa is excluded, sub-Saharan Africa generation capacity falls to 28 GW, about the same as Argentina[7]. The installed capacity per inhabitant in Africa is the weakest in the world, with 0.15 kW per capita. Excluding South Africa from the sub-Saharan Africa figure, the corresponding value drops further to 0.10 kW, far below all other regions of the world.

[7] International Monetary Fund (IMF) (2008). Regional economic outlook: sub-Saharan Africa. Retrieved on 29 November 2012 from: http://www.imf.org/external/pubs/ft/reo/2008/afr/eng/sreo0408.pdf

Figure 4. Installed capacity per inhabitant (kW per inhabitant)

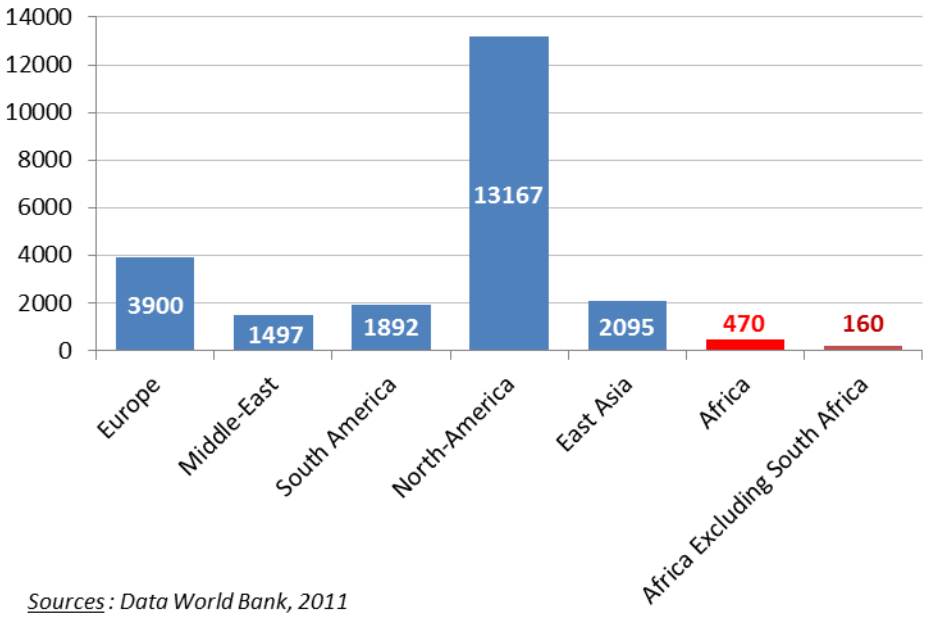


Source : US Energy Information Administration, 2010

With a population of nearly 800 million people, average yearly per capita electricity use in sub-Saharan Africa is approximately 440 kWh. With the exclusion of South Africa, per capita electricity decreases to 160 kWh[8]. In comparison, Europe's population is estimated at 502 million people and has per capital electricity consumption of about 6,000 kWh[5].

[8] UNEP en.lighten initiative (2012). Country lighting assessments. Retrieved 29 November 2012 from: http://www.enlighten-initiative.org/portal/CountrySupport/CountryLightingAssessments/tabid/104272/Default.aspx

Figure 5. Installed electricity consumption per inhabitant (kWh per year)



Sources : Data World Bank, 2011

Current regional electricity situation

With 15% of the world's population, Africa accounts for only 3% of worldwide electricity consumption[9] with 329,895 GWh consumed per year. The overall access rate to electricity in sub-Saharan Africa is nearly 30%, but only 10% for sub-Saharan rural households.

[9] Heuraux, Christine (2010). L'électricité au cœur des défis Africains.

The following table gives an overview of commercial electricity availability.

Table 1. Electrical situation at place of work[10]

Country	No electricity at place of work*	At least one day of power cut in the last 7 days	Always had electricity
MEDIANS	69%	25%	6%
Niger	92%	7%	1%
Burkina Faso	91%	9%	1%
Central African Republic	89%	10%	1%
Sierra Leone	87%	9%	4%
Chad	72%	27%	1%
Uganda	70%	25%	5%
Ghana	69%	21%	10%
Kenya	58%	24%	18%
Cameroun	58%	35%	7%
Tanzania	54%	39%	7%
Zimbabwe	53%	41%	6%
Senegal	48%	41%	11%
Nigeria	41%	59%	0%
South Africa	12%	29%	59%

* *includes those who say their workplace is always on a generator*
Source: Survey conducted in 2010 with face-to-face interviews, source GALLUP social and economic analysis

The anticipated trend is alarming. By 2030, half of the global population without electricity will live in sub-Saharan Africa[11]. At the current electrification rate, most of the countries in the region will not reach 100% electrification by 2050.

[10] Gallup (2012) In sub-Saharan Africa, most workers are without electricity. Retrieved on 29 November 2012 from: http://www.gallup.com/poll/151889/sub-saharan-africa-workers-without-electricity.aspx
[11] International Energy Agency (2009). World Energy Outlook. Retrieved on 29 November 2012 from: http://www.worldenergyoutlook.org/media/weowebsite/2009/WEO2009.pdf

Table 2. Sub-Saharan Africa electricity power sector

		Electricity sector			Emissions	
Country	**Population (millions)**	**Installed capacity[12] (MW)**	**Electricity consumption per capita (kWh)**	**Electrification access rate (% of population)**	**GHG (kt of CO_2)**	**GHG (metric tons per capita)**
Angola	19.1	1,155	203	26	24,371	1.35
Benin	8.9	93	92	25	4,067	0.49
Burkina Faso	16.5	252	43	15	1,856	0.12
Cameroon	19.6	1,105	266	49	5,302	0.28
Cape Verde	0.5	75	422	70	308	0.63
Central African Republic	4.4	46	37	5	260	0.06
Chad	11.3	158	9	4	495	0.05
Côte d'Ivoire	19.8	1,218	187	49	7,015	0.37
Democratic Republic of Congo	66.0	2,476	104	11	2,816	0.05
Ethiopia	83.0	929	45	17	7,107	0.09
Gabon	1.5	415	924	37	2,472	1.70
Gambia	1.7	75	136	5	411	0.25
Ghana	24.4	2,111	265	61	8,592	0.37
Guinea	10.0	331	102	20	1,393	0.15
Guinea-Bissau	1.6	15	10	12	282	0.19
Kenya	1.5	1,286	146	16	10,392	0.27
Lesotho	1.7	76	253	16	--	--
Madagascar	20.3	246	46	19	1,911	0.10
Malawi	14.9	315	85	9	1,228	0.09

[12] The installed capacity represents the total power installed but does not represent the available capacity which can be much lower whether or not plants are active.

		Electricity sector			Emissions	
Country	Population (millions)	Installed capacity[1] (MW)	Electricity consumption per capita (kWh)	Electrification access rate (% of population)	GHG (kt of CO_2)	GHG (metric tons per capita)
Mauritania	3.5	253	145	50	1,999	0.61
Mauritius	1.3	739	1,870	99	3,953	3.12
Mozambique	23.4	2,428	453	12	2,314	0.1
Namibia	2.3	264	1,628	34	3,968	1.8
Niger	15.6	230	40	9	851	0.06
Nigeria	158.4	5,900	120	51	95,756	0.64
Rwanda	10,6	67	22	5	704	0.07
Senegal	12.5	548	189	42	4,976	0.42
Seychelles	85.2	95	2,660	96	682	7.84
Sierra Leone	5,8	52	11	10	1,335	0.24
South Africa	50	44,100	4,532	75	435,878	8.93
Sudan	43.1	2,300	115	30	NA	NA
Swaziland	1.2	70.1	943	35	1,093	1.06
Tanzania	44.9	1,006	84	14	6,465	0.15
Togo	6.1	85	99	20	1,419	0.25
Uganda	34	515	40	9	3,748	0.12
Zambia	12.9	1,680	625	19	1,889	0.15
Zimbabwe	12.6	2,099	1,022	42	9,076	0.73

Source: Country questionnaire, IRENA, World Bank, IEA – 2011

2.1 Trading patterns for lighting products

Reported data for the trade of lighting products in the sub-Saharan Africa region is very limited. However, general trends can be observed from trade that is reported in the UN COMTRADE Database. Trade data (Appendix 3) shows China as the source of approximately 70% of reported trade of lighting products in the region. Germany, South Africa, The Netherlands, Hungary, and Portugal also supply lighting products to the region. The destination of these lighting products is concentrated in four countries (South Africa, Nigeria, Ghana and Angola), which account for approximately 75% of imports to the region.

2.2 The environmental situation: carbon dioxide emissions and climate change

The lighting sector accounts for 6% of worldwide greenhouse gas (GHG) emissions with 682,343 kt of CO_2 being emitted in 2008. Sub-Saharan African countries account for less than 3% of worldwide emissions[13]. Despite the limited contribution of this region to climate change, sub-Saharan Africa countries suffer from the adverse consequences of global climate change. The lighting sector significantly contributes to Africa's greenhouse gas emissions, as lighting represents a large share of total energy consumption and electricity generation is predominantly based on fossil fuels utilizing less efficient open cycle technology.

2.3 The impact of efficient lighting

In Africa, retrofitting one million inefficient incandescent lamps with the equivalent number of efficient lamps can shave peak hour demand by 50MW and save an average 30,000 tCO_2 equivalent/year[14].

Table 3. Estimated impact of retrofitting inefficient incandescent lamps with energy efficient CFLs[15]

One million 60 W inefficient incandescent lamps retrofitted with	Peak load shaving potential (MW) at peak load	Saved energy per year (GWh/year)	Saved GHG emissions ($ktCO_2$ per year)
14W CFLs	51	47	33
9W LED lamps	57	53	37

Virtual Power Plants

The figures above demonstrate that the transition to efficient lighting has a significant impact on the electricity sector, primarily on peak demand. For example, according to the Ministry of Power in Nigeria, lighting represents up to 60% of the total peak load.

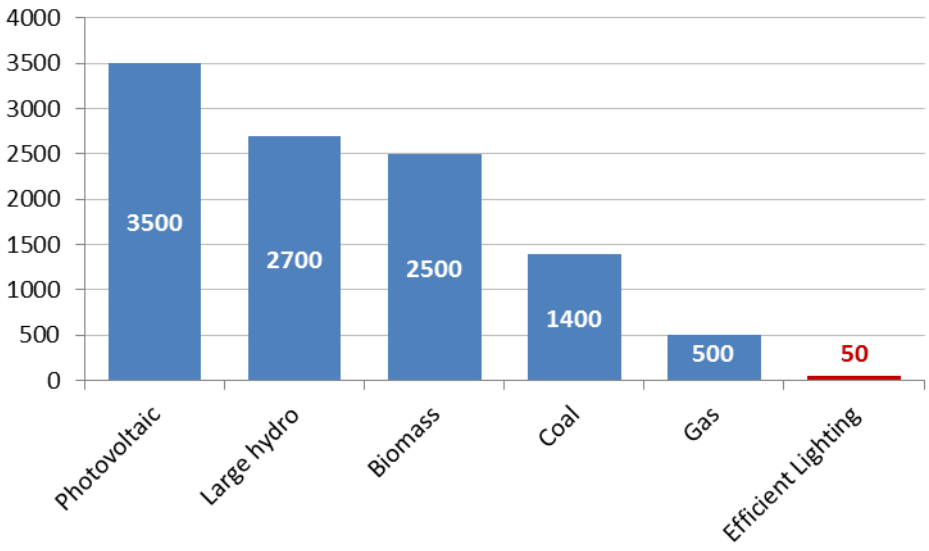
[13] World Bank (2008). Retrieved on 29 November 2012 from: http://data.worldbank.org/indicator/EN.ATM.CO2E.KT/countries/1W-ZG?display=graph

[14] Average African Grid Emission Factor = 0.7tCO2/MWh – Source: U.S. Department of Energy Information Adminstration. Retrieved on 29 November 2012 from: http://www.eia.gov/oiaf/1605/pdf/Appendix%20F_r071023.pdf

[15] Calculations made according to UNFCCC CDM approved AMS.II.J methodology: Demand-side activities for efficient lighting technologies. Retrieved on 29 November 2012 from: http://cdm.unfccc.int/methodologies/DB/5RMYBVTQ83H9CJA99M2392TSNO9IUJ

Efficient lighting also could contribute to the elimination of investment costs for the commissioning of new power plants. More importantly, since there are additional investment requirements for peak hour production, it is advantageous to implement demand side management rather than adding peak load capacity. **Erreur ! Source du renvoi introuvable.** shows that the transition to efficient lighting requires lower investment compared to the cost of additional installed capacity.

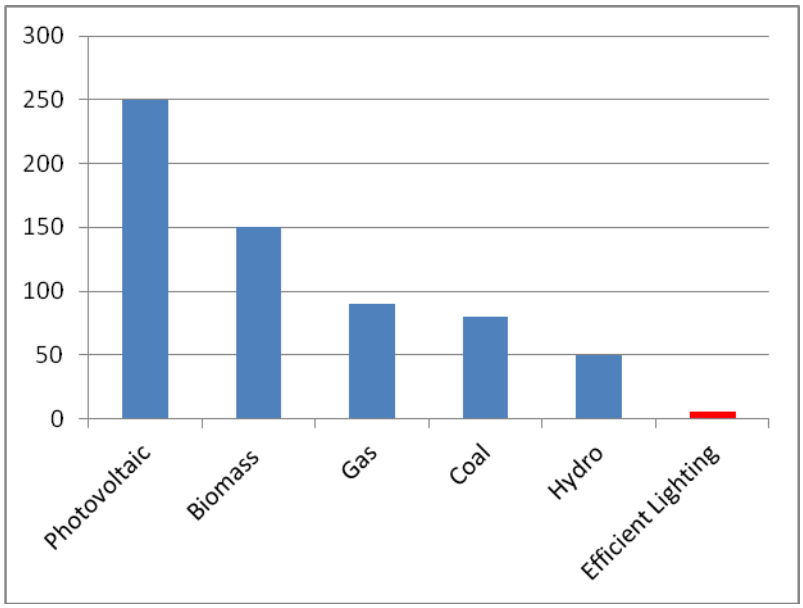
Figure 6. Comparison of installed capacity costs (euros per kW)



Source : L'électricité au coeur des défis africains, Chritine Heuraux, 2009

Considering the current economic state of sub-Saharan Africa, efficient lighting can play a critical role in the abatement of CO_2 while increasing the availability of additional power. Also, in Figure 6, the cost of the MWh associated with inefficient lighting technologies is far higher than the cost of the MWh saved by transitioning to efficient lighting. Therefore, it makes more fiscal sense for countries in sub-Saharan Africa to save electricity through efficient lighting rather than establishing new generation capacity in the region.

Figure 7. Compared cost of energy technology (euros per MWh)



The transition to efficient lighting should be considered as a priority activity to limit the intensity and frequency of power outages, and to avoid subsidizing electricity generation and distribution.

3. Obstacles to the transition to efficient lighting

Inefficient incandescent lamps remain the dominant technology and will continue to be more widespread than efficient lighting technologies, unless the barriers associated with the adoption of efficient lighting technologies are addressed through policy initiatives. The high initial cost of efficient lighting products appears to be the greatest challenge to their rapid adoption.

3.1 Technical barriers

Need for product quality systems

The quality of efficient lighting is a key component of a successful transition. Low quality energy efficient lamps deliver poor performance which will result in lamps not meeting the expected energy and greenhouse gas savings, hampering policies and project implementation.

Failure to meet consumer expectations, both in terms of illumination and the reduction in electricity bills will therefore reinforce the dominant position of inefficient incandescent lamps in the market.

Efficient lighting technology

In order to be successfully implemented in sub-Saharan African countries, efficient lighting technology has to comply with local network constraints and limitations.

Power factor

The question as to whether or not utilities and policymakers should be concerned about the power factor of CFLs is often raised. Grids operate most efficiently when the collective load (all connected and operating devices including lamps, appliances, motors, etc.) on the grid has a power factor close to 1.0 and does not vary with time. Some CFLs have a power factor below 0.6. Though no negative impact on the grid has been observed, including in those areas where CFLs are widely installed (such as Europe), some organizations, such as electric utility companies, advocate for high power factor (>0.9) CFLs.

Research and studies to date do not support the need for high power factor CFLs[16] and the additional costs that are associated with this technology. For this reason, the decision making process that leads to the adoption of efficient lighting measures or policies requires clarification and prioritization of policy goals; the evaluation of local electrical infrastructure conditions; and, an assessment of local market conditions.

Voltage fluctuation

Most African country electrical grids can experience high voltage fluctuations. When the input voltage fluctuates beyond the range of 170-250V, there is an increased occurrence of electronic circuit failure. The greater the variation, the greater the chance the circuit will fail. CFLs and LED lamps can be made resilient against voltage swings and surges by the addition of components in the electronic circuitry that will stabilize the input voltage. Testing protocols are important and must be adapted to the specifications within the region in order to withstand voltage fluctuation.

Power outages

Though efficient lighting helps to address power outages, those technologies adopted should be appropriate to address issues relating to power cycles and frequent black-outs. When alternate

[16] United States Agency for International Development (USAID) (2010). Power factor: Policy implications for the scale-up of CFL programs. Retrieved on 29 November 2012 from: http://www.cleanenergyasia.net/sites/default/files/resources/Power_Factot_Report_Final_0.pdf

back-up or emergency systems are installed, efforts should be made to use efficient lamps to reduce fuel consumption.

3.2 Market and information barriers

There is general lack of information and awareness about the energy and power savings potential of energy efficient lighting, both on the part of consumers as well as policy makers. Additionally, there is a lack of institutional capacity to implement energy efficiency programs for the end-user. Energy efficient lighting and energy efficiency on a global scale are not given due consideration at the fiscal, regulatory and policy level. Therefore, awareness raising and communications activities must not be neglected, to maximize chances of adoption of efficient lighting in the market.

There is not any accurate data available on the penetration rate of efficient lighting technologies in sub-Saharan Africa. However, some experts consider that this rate does not exceed 10% to 15% in most developing countries[17]. Higher market prices and concerns about product quality seem to be the main reasons for this limited penetration.

Information on the real price of efficient lighting

Inefficient incandescent lamps remain the least expensive technology for end users.The initial cost of efficient lighting can be seen as the biggest hurdle to be overcome. CFLs are available in every sub-Saharan Africa country LED lamps, while obtainable, are not as prevalent, especially in the consumer market. Though more cost-effective than incandescent lamps for consumers over their rated life, there is limited incentive for consumers to purchase energy efficient alternatives. Low income levels combined with lack of subsidies on efficient lighting products lead consumers to continue to purchase lower cost inefficient incandescent lamps.

In this context, education and awareness raising campaigns can contribute to increase usage of efficient lighting technologies. These campaigns highlight the benefits of efficient lighting and include messages such as:

- Efficient lighting products consume much less energy than inefficient incandescent lamps for the same lumen output. Consumers' electricity bills will be reduced.
- Efficient lighting has a longer rated lifetime than incandescent lamps[18], resulting in fewer purchases contributing to income savings.

[17] Energy Sector Management Assistance Program (ESMAP) (2009). Large-Scale Residential Energy Efficiency Programs Based on CFLs. Retrieved on 29 November 2012 from: http://www.esmap.org/sites/esmap.org/files/CFL_Toolkit_Web_Version_102110_REVISED_FINAL.pdf

[18] U.S Department of Energy. Energy 101: Lumens. Retrieved on 29 November 2012 from: http://www.energysavers.gov/your_home/lighting_daylighting/index.cfm/mytopic=12060

In spite of high awareness levels, consumers with weak purchasing power continue to buy inefficient incandescent lamps. Therefore, supporting policies and financial incentives are necessary to achieve a transition to efficient lighting. The implementation of fiscal policies and subsidies as well as the utilization of promotional mechanisms have a positive impact on the penetration of efficient lighting.

Split incentives

A transition to efficient lighting requires that each party involved understands the economic advantages and can track the savings from investments in efficient lighting. The higher initial cost of efficient lighting products is a purchasing barrier for owners, developers and public authorities, even if they understand the environmental and economic benefits of efficient lighting products[19]. This is attributable to either misplaced or split incentives among stakeholders[20], leading to a reduction in investments for energy efficient lamps. Some examples of split incentive scenarios include:

Utility-Consumer Incentive Conflict: lack of metering systems prevents the large-scale implementation of efficient lighting programs. Without appropriate metering equipment, consumers fear that the utility will benefit from their financial efforts and so they are not inclined to adopt energy efficient lighting.

Landlord-Tenant Incentive Conflict: landlord/owners attempt to minimize the higher investment cost of the lighting system, while residents seek to reduce the cost of their electricity bills. In this case, the landlord/owners have little or no incentives to buy higher cost, energy efficient lamps. Tenants do not receive any incentives so they are not motivated to adopt energy efficient lighting.

Perceived risks of new efficient lighting technologies

Environmental and health

Efficient fluorescent lamps contain a small amount of mercury. No mercury is emitted from lamps during operation. However, if broken, mercury may be released. Regulations in developed countries limit the amount of mercury found in CFLs. For example, the European

[19] European Lamp Companies Federation (2007). Make the switch. The ELC road map for deploying energy efficient lighting technology across Europe. Retrieved on 29 November 2012 from: http://www.elcfed.org/documents/-56-finelc_road_map_11_07.pdf

[20] Golove, W. and Eto, J. Lawrence Berkely National Labroratory (1996). Market barriers to energy efficiency: A critical reappraisal of the rationale for public policies to promote energy efficiency. Retrieved on 29 November 2012 from http://eetd.lbl.gov/eap/EMP/reports/38059.pdf

Union RoHS 2002/95/CE directive[21] has imposed maximum mercury content per CFL to 5 mg. The majority of leading lamp manufacturers have reduced mercury content to a maximum of 3.5 mg per CFL and are looking to reduce that further to 2.5 mg as of January 1, 2013.

A similar approach is required in developing countries. The issue of mercury must be treated at the source by limiting the quantity of mercury per lamp which would result in a reduction in the overall quantity of mercury in the market. Safer production techniques combined with increasingly stringent environmental regulations can reduce mercury levels.

Social acceptance

Consumer behavior can also be considered as a barrier to the implementation of new efficient lighting technologies. For example, in some regions, tropical climates may have lower temperatures at night. Consumers may consider the heat generated by inefficient incandescent lamps as an asset which creates a behavioral barrier to the adoption of efficient lighting.

In countries where power outages are frequent, consumers keep lamps switched on. These lamps are used as a warning system to indicate when the power supply is restored. Behavioral barriers should be identified in each country to adapt the policy to transition to efficient lighting technologies.

Political context

The barriers over new lighting technologies are not only technical and environmental, but also political in nature. There is a risk of corruption in the transition to efficient lighting. For example, the lamps from a free distribution program could be embezzled and sold, which could affect the penetration rate and the overall distribution.

Learning from Clean Development Mechanism (CDM) schemes can help in alleviating barriers. Customized packaging bearing "Not for Resale" in a country's native language, both on the packaging and the lamp, can prove to be an effective deterrent.

Political instability is one of the challenges for promoting energy efficiency identified by the East Africa Power Pool (EAPP) [22]. Indeed, political instability in different forms throughout sub-Saharan Africa including coups d'états, ethnic and civil wars and frequent turnover of government and officials, makes it difficult to implement effective and adequate efficient lighting programs. In addition, long term effectiveness may also be threatened by the political

[21] EUR-Lex (2002). Directive 2002/95/EC of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment. Retrieved on 29 November 2012 from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32002L0095:EN:HTML

[22] Eastern Africa Power Pool (EAPP) (2010). Energy Efficiency Workshop. Retrieved on 29 November 2012 from: http://www.eappool.org/eng/PPTs/EAPP_Egypt.pdf

instability. For instance, a World Bank initiative in Côte d'Ivoire to promote efficient lighting has taken nearly five years to realize positive outcomes from the first stage[23].

4. The transition to efficient lighting

Though difficult to measure precisely in most sub-Saharan Africa countries, inefficient lighting technologies remain the market leaders. Taking into account higher lighting loads, switching to efficient lighting would undeniably represent a significant improvement by reducing:

- The frequency and intensity of power outages
- Subsidies for electricity through the reduction of electricity consumption
- Greenhouse gas emissions
- End user electricity bills

To ensure that such a transition is effective and self-sustaining, a cohesive set of national and regional actions need to be designed and implemented. These regional actions would act as cornerstones of energy efficiency and should include:

- Minimum energy performance standards (MEPS)
- Supporting policies and mechanisms
- Monitoring, verification and enforcement
- Environmentally sound management

In sub-Saharan Africa, most of the countries that have initiated efficient lighting programs usually involve bulk procurement and the distribution of energy efficient lamps that rely on international donors or private sector funds utilizing carbon financing. The number of lamps distributed is often determined by the desired level of peak reduction[24].

Successful implementation usually involves the following components:

- High quality lighting products
- Increased awareness
- Aggressive promotional activities
- Financial incentives

Regarding the quality of the lighting products, most countries in the region do not have any MEPS in place, nor do they have testing, certification and labeling. Some countries in the region

[23] Interview with Direction de l'Energie, Côte d'Ivoire

[24] World Bank (2008). Large Scale CFL Deployment Programs. Retrieved on 29 November 2012 from: http://www.energyrating.gov.au/wp-content/uploads/Energy_Rating_Documents/Library/Lighting/Lighting/2008-phase-out-session4-sarkar.pdf

have expressed an interest in developing and establishing appropriate standards and such initiatives must be identified, supported and encouraged.

The most commonly used approach for phasing out inefficient lamps has been the use of fiscal policies and educating consumers on the benefits of energy efficient lighting. Since 2008, some countries have also eliminated import duties on energy efficient technologies and appliances (see Part 4: National Case Studies). Although this is significant development, in the absence of rigorous testing standards, these incentives may encourage the adoption of poor quality products.

Policies and mechanisms

Policies and mechanisms can be utilized effectively to phase out inefficient lamps and should include:

- MEPS
- Mandatory labeling and certification
- Voluntary certification and labeling
- Cooperative procurement, subsidies, rebates and free distribution
- Tax increases or exemptions
- Awareness raising, promotion and education
- Installment payments or on-bill financing

Table 4 provides an overview of various policies and mechanisms that have been applied in countries throughout sub-Saharan Africa.

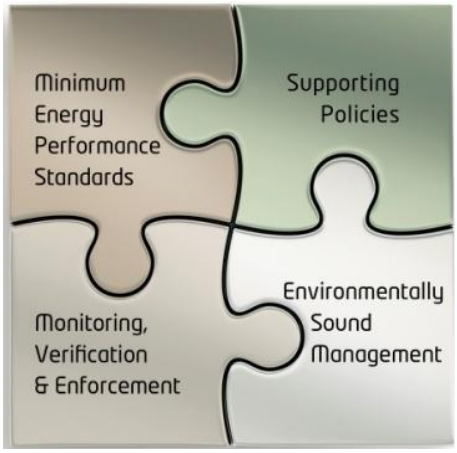
Table 4. Energy efficiency policies and measures applied in sub-Saharan Africa

Policies and Measures	Countries
MEPS	Ghana
Removal of duties and taxes	Uganda, Rwanda, Gambia
Bulk procurement with and without cost recovery	Rwanda, Ghana, South Africa, Uganda
Integrating CDM benefits (Program of Activities registered or on validation)[25]	Rwanda, Ghana, Senegal, South Africa, Malawi, Kenya, Nigeria, Togo, Chad
Branding with cooperative advertising & promotion	Uganda, Rwanda

[25] UNFCCC. Clean development mechanism. Retrieved on 21 November 2012 from :http://cdm.unfccc.int/

Although policies and mechanisms, like MEPS, are vital for achieving energy efficiency, they must be considered as a part of an integrated approach. Therefore, these activities should be implemented in close connection with the other elements of the integrated approach to ensure an effective and rapid transition.

Figure 8. UNEP en.lighten integrated policy approach



Production and manufacturing of efficient lamps

There are two facilities in Ghana and one facility in Lesotho, established in 2009[26]. There is no existing LED lamp or other efficient lighting plant reported in sub-Saharan Africa, although one is planned in Nigeria[27].

Sustainability and environmentally sound management

Mercury is essential for the manufacturing and operation of CFLs. While risks associated with a single CFL are generally considered as negligible[28], the cumulative impact of millions of CFLs does become a more significant issue and could represent potential health and environmental risks. None of the sub-Saharan Africa countries have implemented legislation concerning the collection, recycling and disposal of mercury added lamps and other products.

[26] Engineering News (2010). Lesotho plant supplies first million CFLs to Eskom. Retrieved on 21 November 2012 from : http://www.engineeringnews.co.za/article/lesotho-jv-supplies-first-million-cfls-to-eskom-2010-05-10
[27] Nwachukwu, Clara. Vanguard (2012). Nigerian firm plans N500m LED lamp factory. Retrieved on 29 November 2012 from: http://www.vanguardngr.com/2012/08/nigerian-firm-plans-n500m-led-lamp-factory/
[28] City of Cape Town, Western Cape, & Eskom (2008) CFL recovery strategy, programme overview. Retrieved on 29 November from: http://www.cityenergy.org.za/files/resources/lighting/CFL%20Recovery%20Programme.pdf

The implementation of MEPS combined with the establishment of adequate testing facilities is important and the design and implementation of environmentally sound management systems can limit the health and environmental impact of mercury-added lamps.

Communication and awareness raising at all stages of transition to efficient lighting will also positively impact the participation of consumers in the collection and recycling of CFLs. Education is necessary for an effective and sound transition to efficient lighting.

5. National case studies by region

The data for this report was successfully collected due to the active cooperation of electricity and power utilities, ministries of energy and ministries of environment; however, there are still some information gaps.The following detailed case studies further describe what has been achieved and what is planned at the country level regarding the transition to efficient lighting. The data includes: energy savings and greenhouse gas emissions reduction; market distribution; and laws and regulations. Presentation of the results for the 37 countries has been organized according the following geographic divisions:

- **Eastern Africa**: Ethiopia, Kenya, Madagascar, Malawi, Mauritius, Mozambique, Rwanda, Seychelles, Uganda, United Republic of Tanzania, Zambia, Zimbabwe
- **Central Africa**: Angola, Cameroon, Central African Republic, Chad, Democratic Republic of the Congo, Gabon
- **Northern Africa**: Sudan
- **Southern Africa**: Lesotho, Namibia, South Africa, Swaziland
- **Western Africa**: Benin, Burkina Faso, Cape Verde, Cote d'Ivoire, Gambia, Ghana, Guinea, Guinea-Bissau, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo

5.1 Eastern Africa

Ethiopia

Ethiopia's electricity supply system is facing a wide range of challenges, from unreliable service to serious shortages in a context of rapidly increasing demand. Inadequate production capacity, combined with inefficient utilization of the electricity network, has a strong negative impact on the environment. Ethiopia has launched successful energy efficient lighting projects and has adopted measures towards a transition to efficient lighting.

Regulatory mechanisms

Ethiopia introduced energy conservation measures in all sectors, including lighting. There are no voluntary or mandatory MEPS regarding the use of energy or the sale of energy efficient products. However, the government does address the need for an energy efficiency policy "*to set, issue and publicize standards and codes which will ensure that energy is used efficiently and properly*."

Supporting policies

The government has reduced import duties on energy efficient equipment and is drafting legislation to introduce energy efficient lamps.

An awareness campaign entitled "Save Energy" was launched, aimed at educating consumers on the benefits of saving energy at home and work. Ethiopia promotes awareness through mass media in the various national languages and there is encouragement for community participation, especially from women.

The Ethiopian Electric Power Corporation (EEPCo) with the support from the World Bank has launched a program for the distribution of 4 million CFLs. Before starting the distribution, EEPCo carried out a large scale survey targeting low income households, provided insight to authorities and informed consumers ahead of time to ensure good reception of the project.

Monitoring, verification and enforcement

There are currently no monitoring or verification processes to ensure product efficiency or conformance to supplier product claims.

Environmentally sound management

Although approximately 350,000 CFLs have been distributed, no information is available on performance, spent lamp collection, recycling or disposal initiatives.

Kenya

Regulatory mechanisms

Kenya launched "The Standards and Labeling (S&L) Program," and was joined in this initiative by four other eastern African countries (Burundi, Rwanda, Tanzania and Uganda). This five-year program is designed to remove barriers for a market transformation to energy efficient products and services[29]. Implemented with support from the Global Environment Facility (GEF), UN

[29] Government of Kenya, Ministry of Industrialization (2012). Standards and labelling programme: Training needs assessment for standards and labelling programme stakeholders. Retrieved on 29 November 2012 from: www.ke.undp.org/index.php/procurements/download/331

Development Programme (UNDP) and the government of Kenya, the program aims to reduce electricity related CO_2 emissions by improving efficiency of selected appliances and equipment in the residential, commercial and industrial sectors. The program will include CFLs, which will have mandatory MEPS in terms of average lifetime, power factor or voltage range. The policy framework[30], under which the Program has been implemented, is currently under review. The energy act (No. 2006[31]), under which major policy decisions were announced, is likely to undergo amendments to include more energy efficient products.

Supporting policies

Energy efficiency programs are at various stages of implementation, both on the supply and demand side. Efficient lighting in the residential sector is considered as a priority under the framework and has led to the replacement of 1.25 million energy efficient lamps in the first phase of the program. In the second phase, 3.3 million energy efficient lamps will be replaced, accompanied by country-wide energy efficiency and energy conservation awareness campaigns. The program targets middle and low income customers and covers grid and off-grid users. To date, awareness raising campaigns carried out in print and electronic media, along with one-on-one interaction, have been successful in promoting the benefits of energy efficient lamps.

Monitoring, verification and enforcement

The Kenya Bureau of Standards (KEBS) has been mandated to develop standards and labeling regulations in the country. It is also involved in enforcement and compliance of standards established by the Standards Development Division (SDD), Metrology and Testing Division (MTD) and Quality Assurance and Inspection Division (QAI). The SDD provides knowledge and skills to guide the development of energy efficiency and labeling standards for each of the product categories. The MTD is responsible for the calibration and testing of all equipment and samples and to issue relevant certificates. The QAI division is responsible for quality assurance and inspection. Its role is to ensure that products conform to the relevant standards.

Environmentally sound management

No information is currently available.

Madagascar

The World Wildlife Fund (WWF), along with the Malagasy Ministry of Energy, the Telma Foundation and JIRAMA (Madagascar's public power utility) launched a project called

[30] Kenya Ministry of Energy (2004). Sessional paper no. 4 on energy. Retrieved on 29 November 2012 from: http://www.erc.go.ke/erc/Regulations/SESSIONAL%20PAPER%204%20ON%20ENERGY%202004.pdf

[31] Kenya Energy Regulatory Commission (ERC) (2006). The Energy Act,, 2006. Retrieved on 29 November 2012 from:http://www.erc.go.ke/energy.pdf

"Lumitsits" in 2011. The project aimed at creating a market for energy efficient lamps within the country to realize energy savings and to provide access to safe energy for all.

Regulatory mechanisms

With regard to lamp performance, JIRAMA was responsible for the quality of the lamps and the overall project. A framework was also agreed upon in order to promote energy efficient lamps at an affordable price and ban incandescent lamps in the country over the long term. Although Madagascar does not have MEPS for lighting products, a labeling system for lamps is being prepared.

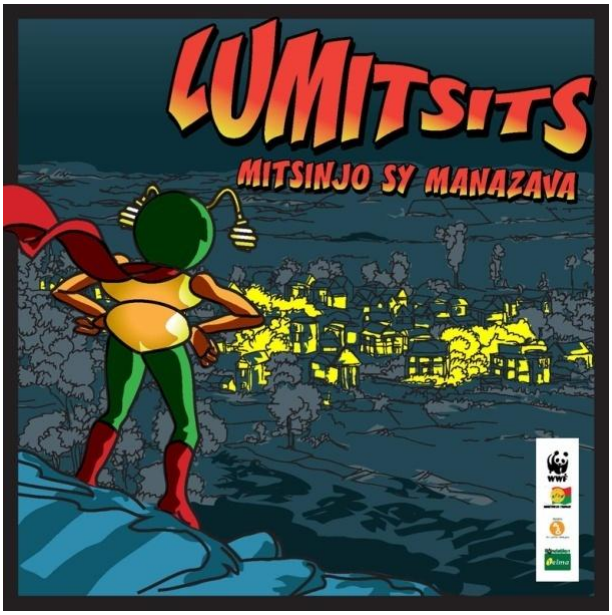
Supporting policies

The objective of Lumitsits is to install 600,000 efficient lamps in the eight largest cities in the country. Six thousand lamps were distributed in Ambositra, the pilot city chosen for the implementation of the project. The project was financed through carbon financing. While the WWF is responsible for the carbon financing, Telma heads the distribution of lamps.

As part of the promotional campaigns, both electronic and print media were used extensively to encourage the participation of end users and stakeholders.

Figure 9 shows an image from the successful advertising campaign featuring a heroic firefly saving villages and lighting the homes in Madagascar.

Figure 9. Leaflet used in Madagascar Lumitsits campaign



The project is implemented through Gold Standard, an independent label that certifies high-quality carbon offset projects and the emission reduction certificates generated by them. Lumitsits is required to comply with Gold Standard's monitoring, reporting and verification rules, throughout the crediting lifetime of the project. The monitoring will include the amount of electricity saved, CO_2 emission reductions, and employment generated.

Monitoring, verification and enforcement

The government has established an institutional framework that relies on the "Centre National de Recherche Industrielle et Technologique" (*National Centre for Technology and Industrial Research*) for testing of the lamps. It is also in the process of establishing compliance standards, through the Border Control System, to halt the import and sale of unauthorized products.

Environmentally sound management

In addition to the collection and disposal of spent CFLs as per the Gold Standard, Madagascar is enforcing Basel Convention guidelines for control of the trans-boundary movement of hazardous waste and disposal.

Malawi

The electric utility, Electricity Supply Corporation of Malawi (ESCOM), procured CFLs at the beginning of 2012 and began a pilot program in 500 households. By the end of July 2012, more than 540,000 CFLs were installed as part as the Efficient Energy Lighting Project (EELP). The program targets the installation of two million CFLs. During the first phase of the program, 1.3 million CFLs were distributed for no charge in exchange for inefficient incandescent lamps and the remaining 700,000 will be sold at a subsidized price. The program achieved a peak load shaving of 17.1 MW.

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

The procurement of the lamps was made through an international competitive tender. The nationwide program, rolled out in April 2012, also had a comprehensive monitoring and verification plan in place to quantify energy savings and peak shaving.

According to the tender documents, the lamps have a rated lifetime of at least 10,000 hours and carry a two year warranty.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

The procurement and distribution program includes a lamp disposal strategy for both CFLs and incandescent lamps and addresses associated risks.

Mauritius

Regulatory mechanisms

Mauritius has established the 156 MS203:2011 standard entitled *"Energy efficiency and labeling requirements – household electric lamps."* The standard specifies energy efficiency and labeling requirements for both residential and non-residential electric lamps.

Supporting policies

The Central Electricity Board (CEB) released and distributed a practical guide for Mauritian households which consists of information on the most commonly used electric household appliances[32].

Monitoring, verification and enforcement

The Mauritius Bureau of Standards, which developed standards for residential lamps, has an engineering division but it does not have the facilities to test lighting products.

Environmentally sound management

CFLs, hazardous wastes and the need to increase the reduce-reuse-recycle mentality are mentioned in the, "Maurice Ile Durable, Green Paper, Towards a National Policy for a sustainable Mauritius."

Mozambique

Mozambique is leading two energy efficient lighting projects. At the beginning of May 2012, the public utility, *Electricidade De Moçambique* (EDM), began the "More Light with Less Energy" project. The project involves the distribution of 200,000 energy efficient lamps to low-energy consumption EDM consumers throughout the country. These lamps were provided under official development assistance from the government of Portugal. Similarly, in the street lighting sector, EDM is undertaking the replacement of street lighting with efficient lamps under the

[32] Mauritian Central Electricity Board (CEB). Energy practical guide . Retrieved on 29 November 2012 from: http://ceb.intnet.mu/save_energy/save_energy.pdf

"Green Street T5" project. The street lamp replacement program, which commenced in 2007, has replaced 80,000 street lamps to date.

Regulatory mechanisms

Though labeling and certification issues have been discussed in several government forums, no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Monitoring, verification and enforcement

EDM defined its own specifications for CFL MEPS for their programs. There are no test methods that have been established nor laboratories to test lighting products in Mozambique. In addition to border controls, market inspections are conducted by the responsible authorities to ensure that unauthorized products are not entering the country.

Environmentally sound management

Regarding environmental issues, there are no collection or recycling and disposal initiatives for lighting products in Mozambique. However, within the CFL distribution program, EDM, in cooperation with various state and municipal authorities, aims to promote the collection and recycling of spent CFLs.

Rwanda

As stipulated in its Economic Development and Poverty Reduction Strategy (EDPRS) based on the *Vision 2020* paper, Rwanda intends to increase its access to electricity from the current 6% to at least 16% by the end of 2012.

Regulatory mechanisms

Though the request has been submitted to Ministry of Infrastructure to develop regulations to deter low quality lamps from being sold in local markets[33], no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been implemented.

Supporting policies

In 2007, Rwanda also developed and launched an efficient lighting CDM project entitled "*Electrogaz Compact Fluorescent Lamps Distribution Project.*" This project was the first efficient lighting CDM project in Africa with the goal of reducing power shortages.

The distribution of energy efficient lamps was conducted around the country. Initially, 50,000 lamps were distributed free of charge and another 150,000 CFLs were supplied and distributed

[33] Questionnaire, The Republic of Rwanda, Mark Rukata – Head of Energy department of DNA.

by the Energy, Water and Sanitation Authority (EWSA) at a low cost (0.3 USD) to encourage people to purchase them and to involve the private sector in the initiative.

Since the project was developed under CDM, a detailed monitoring plan has been put into place. According to the plan, Electrogaz will be in charge of monitoring, while monitoring surveys will be conducted by external consultants. The monitoring plan measures and verifies the lifetime of the lamps in order to evaluate precise energy savings and greenhouse gas emission reductions.

According to the Electrogas CDM project, in order to prevent inefficient incandescent lamps from re-entering into the market, destruction or recycling of the lamps has to be certified by an independent body.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

Currently, an environmental impact assessment on the disposal of inefficient incandescent lamps is underway by the National University of Rwanda. The future course of action for the disposal and recycling of the lamps will be determined by the Rwanda Development Board.

Seychelles

Seychelles launched a program aimed at promoting efficient lighting in the residential, commercial and industrial sectors to conserve energy and raise awareness among users. The strategy adopted focused specifically on the replacement of inefficient incandescent lamps with CFLs in public and government buildings and in the commercial sector[34].

No data has been recorded on the number of CFLs imported, inefficient incandescent lamps replaced or the impact on reduced electricity demand.

Regulatory mechanisms

Plans to develop and implement MEPS and other regulations for lighting products have been deliberated. Given the electricity consumption structure, priority has been given to establishing MEPS for air conditioners and refrigerators.

Supporting policies

Through its Energy Efficiency Communication Strategy 2012-2015, Seychelles has already implemented energy efficiency promotional and educational campaigns. The social benefits

[34] Moustache, Antoine (2005). Assessment of technology transfer in Seychelles within the context of climate change. Retrieved on 29 November 2012 from: http://unfccc.int/ttclear/jsp/CountryReports.jsp

focus on reduced electricity consumption and savings for consumers. The campaign focused on lower income residential consumers who have traditionally purchased inefficient incandescent lamps due to their low initial cost. The awareness campaign highlighted the overall energy and cost savings from a shift to CFLs.

Importers were made aware of the benefits associated with the use of CFLs, and were encouraged to import and sell CFLs. To prompt this action, taxes on the import of CFLs were eliminated[35] and thus, today, CFLs are readily available in the local market. The exercise to introduce CFLs took approximately one year with the majority of effort spent on the awareness-raising campaign.

The replacement of inefficient incandescent lamps with CFLs is mandatory for the commercial and institutional sectors and has resulted in a positive environment to support the market.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No overall strategy or management plan has been reported.

Uganda

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Uganda is one of the pioneers in the implementation of energy efficient lighting programs in Africa. Uganda's initiative in promoting energy efficiency was led by the Ministry of Energy and Mineral Development as early as 1999[36]. After several rounds of detailed discussions and as part of the program implementation, a request for bid on a CFL distribution project was issued in 2002. Technical specifications for the project were issued based on IFC/GEF Efficient Lighting Initiative (ELI). The objectives of the program were to:

- Ease Uganda's investment in system expansion caused by rapid demand growth
- Assist end users in the districts served by UMEME with reduced electricity tariffs
- Reduce GHG emissions and improve the global environment

[35] Ibid.

[36] UN Division of Sustainable Development. Uganda's initiative in promoting energy efficiency. Retrieved on 29 November 2012 from: http://www.un.org/esa/sustdev/csd/casestudies/e3_uganda.pdf

The program to distribute a maximum of three CFLs per household was undertaken by UMEME, the privately owned power utility. International competitive bidding was conducted in July of 2006 to select a supplier for a total of 800,000 CFLs. The collection of inefficient incandescent lamps and the distribution of CFLs were conducted through the UMEME Yellow Pages. A campaign poster used for the distribution of CFLs is shown below in Figure 10.

The marketing and promotion of CFLs raised overall awareness but, a post implementation survey pointed out several issues with the marketing program[37]:

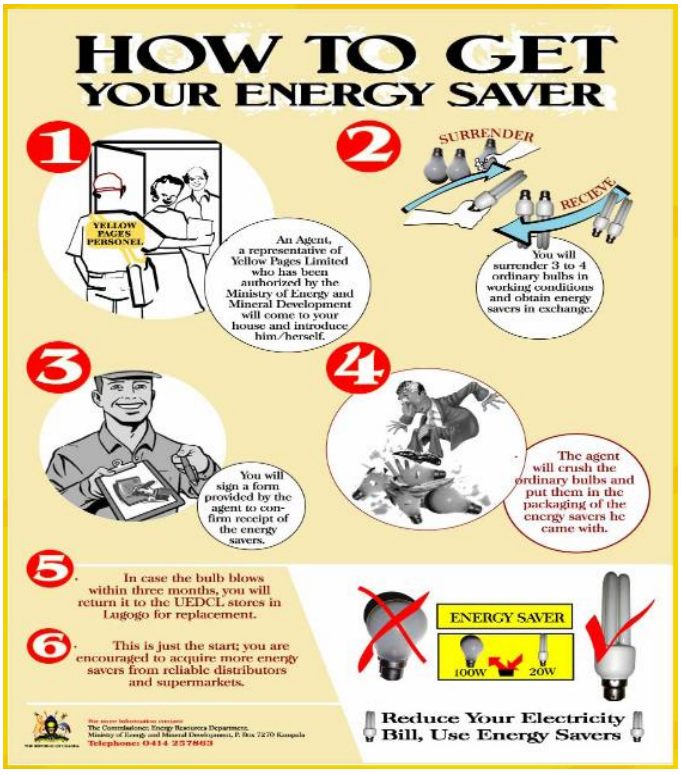
- Awareness was low in areas outside Kampala, the capital, especially in the rural areas.
- For two weeks, awareness campaigns were conducted using both electronic and print media. However, many people in the sample group did not receive enough information because the urban radio stations used were inaccessible to rural communities. Additionally, the posters were printed in English and the campaigns failed to improve awareness levels in communities of non-English speakers.
- Since the uniform of the staff of Yellow Pages is similar to that of a major political party, it created resistance in some areas as the consumers associated the CFL program with a political campaign.

It is estimated that 100,000 CFLs and 1.5 million inefficient incandescent lamps were being sold annually in Uganda at the time that program implementation began, and the latest figure translates into an additional market for 500,000 to 600,000 CFLs [38].

[37] Energy Sector Management Assistance Program (ESMAP) (2009). Case study Uganda compact fluorescent program Retrieved on 29 November 2012 from: http://www.esmap.org/esmap/sites/esmap.org/files/15.%20Uganda_Case_Study_V1_032709.pdf

[38] Energy Sector Management Assistance Program (ESMAP) (2009). Case study Uganda compact fluorescent program Retrieved on 29 November 2012 from: http://www.esmap.org/esmap/sites/esmap.org/files/15.%20Uganda_Case_Study_V1_032709.pdf

Figure 10. Example of poster displayed during the advertising campaign in Uganda



There is no local manufacturing capacity, so CFLs and inefficient incandescent lamps were imported. Applicable tax on such imports includes import duty of 25% and VAT of 18%. However, while the main contributing factor for the lower unit price was the volume purchase, it should be noted that under World Bank procurement regulations, it does not allow for payment of import duties or taxes and therefore, the government waived such import tariffs which supported the penetration of CFLs.

Monitoring, verification and enforcement

The Uganda National Bureau of Standards has an electrical testing laboratory. The testing of lighting and other electrical appliances are conducted to assess quality as per Ugandan and International Standards[39]. In preparation for the Uganda CFL Program, a survey was conducted on residential customers to establish the following criteria[40]:

[39] Uganda National Bureau of Standards. Retrieved on 29 November 2012: http://www.unbs.go.ug/main.php?menuid=30

[40] Energy Sector Management Assistance Program (ESMAP) (2009). Case study Uganda compact fluorescent program Retrieved on 29 November 2012 from: http://www.esmap.org/esmap/sites/esmap.org/files/15.%20Uganda_Case_Study_V1_032709.pdf

1. The types and nature of residential lighting used in the capital (Kampala) area
2. The area's normal lighting practices
3. The extent of consumer awareness of energy saving lamps available in the market
4. Consumer perception of CFL technology

Environmentally sound management

No strategy or management plan has been reported.

United Republic of Tanzania

The United Republic of Tanzania has initiated a project for the supply of lighting systems, but not as a replacement program.

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported. However, the Ministry of Energy has indicated an interest in implementing MEPS.

Supporting policies

No supporting policies have been reported.

Monitoring, verification and enforcement

There is no testing laboratory for lighting products in Tanzania. However, the Electrical Engineering Section of the Tanzania Bureau of Standards has the capability to test electrical appliances as well as electrical materials.

Environmentally sound management

Tanzania focuses on electronic waste disposal and some of the entities involved have established facilities and/or systems for the safe disposal of CFLs.

Zambia

Regulatory mechanisms

In 1994, the government of the Republic of Zambia announced a national energy policy to guide administration of the sector. The Energy Regulation Act was introduced to replace The Electricity Act thereby, paving the way for the establishment of a regulator - The Energy

Regulation Board. No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products otherwise have been reported.

Supporting policies

ZESCO, the national electrical utility, assumed various short and long term measures including the replacement of inefficient incandescent lamps with CFLs. Under this program, six CFLs (with < 3 mg of mercury) were distributed free of charge to households. The project was funded and assisted by The World Bank. To promote the transition to efficient lighting, ZESCO focused on:

- The deferral of duty and value-added tax (VAT)
- Partnership with retailers
- Encouraging the use of CFLs by consumers

ZESCO encouraged customers to participate in a free exchange of inefficient incandescent lamps through an awareness campaign conducted in the print media. A component of the campaign is shown in Figure 11.

Figure 11. Advertisement for a CFL swap in Zambia

Monitoring, verification and enforcement

The Zambia Bureau of Standards (ZABS) is a national institute that formulates standards and quality procedures. Although ZABS has testing laboratories, none of the laboratories have the capability to test lighting products. Nevertheless, ZABS is best suited to help develop and implement MEPS and labels for energy efficient lighting products.

Through its program, ZESCO encouraged consumers to dispose of CFLs responsibly, as with other electronic waste.

Environmentally sound management

No strategy or management plan has been reported.

Zimbabwe

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

As an immediate response to relieve load-shedding, Zimbabwe Electricity Supply Authority (ZESA) decided on a CFL giveaway program. The project aims to distribute of 5.5 million CFLs at no cost to end users. Although the project aims at phasing out inefficient incandescent lamps, no monitoring plan has been made available on both the inefficient incandescent lamps and CFLs.

ZESCO also decided to limit the mercury content of CFLs to a maximum of 3 mg to mitigate the associated environmental risks. The disposal of CFLs will be in line with municipal hazardous waste guidelines. Spent CFLs will be deposited in collection drums at designated shopping centers and municipal offices. Until this has been implemented, instruction will be given that CFLs should be placed in a plastic bag and disposed of with regular refuse.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

5.2 Central Africa

Angola

Regulatory mechanisms

In Angola, there are no restrictions on the usage of inefficient incandescent lamps. No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Under the Designated National Authority, the country is currently implementing two CDM projects involving the replacement of inefficient incandescent lamps with energy efficient lighting.

Monitoring, verification and enforcement

All lamps are imported and there is no laboratory to test lighting products. Regulation specifies that imported products have to be certified before entering the country. The inspection process includes examination of a product's registration and energy efficiency specifications however, there are no specific regulations or requirements in place.

Environmentally sound management

There are no collection, recycling and disposal initiatives for lighting products. The Strategic Planning for Waste Management initiative was approved in August 2012 but no regulations have been established to date. The regulations will include guidelines for waste classification and the handling and disposal of hazardous waste. The Strategic Planning for Waste Management regulation will include guidelines for mercury handling and disposal.

Cameroon

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

No supporting policies are currently being implemented.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported

Environmentally sound management

No strategy or management plan has been reported.

Central African Republic

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

ENERCA, the national electricity utility of Central African Republic, is willing to distribute efficient lamps to reduce electricity demand from the lighting sector. A distribution plan for efficient lighting is under consideration for both the residential and street lighting sectors.

Monitoring, verification and enforcement

The Central African Republic lacks testing facilities for lighting products, although some of the academic universities have the required skill-set for conducting testing.

Environmentally sound management

No strategy or management plan has been reported.

Chad

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Chad is currently engaged in a CDM project to distribute 1 million CFLs to replace inefficient incandescent lamps. This initiative includes raising awareness through various media campaigns on the benefits of a transition to efficient lighting.

As it has been developed under CDM, the project includes a monitoring plan to measure and verify the rated life of the replacement CFLs over a 10 year period.

In addition, to prevent inefficient incandescent lamps from re-entering into the market, Ministry of the Environment has established a concrete framework for the destruction of inefficient incandescent lamps and CFLs in the presence of an independent body.

The project also encompasses the development and implementation of a collecting scheme, as well as an educational campaign to encourage end users to dispose of spent CFLs in collection points.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

Democratic Republic of the Congo

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Awareness raising campaigns would be planned as part of a distribution project in order to educate users on the benefits of efficient lighting and to encourage their participation in a project.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

Gabon

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Gabon has considered the phase-out of inefficient lighting but has not taken significant action to date.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported

Environmentally sound management

No strategy or management plan has been reported.

5.3 Northern Africa[41]

Sudan

Regulatory mechanisms

Sudan plans to design and implement MEPS, including a labeling system. The Ministry of Water Resources and Electricity and the Sudanese Standards & Metrology Organization will play a critical role in the design, planning, developing and implementation of the regulatory mechanism.

Supporting policies

Though no policies to support transition to efficient lighting have been instituted, Sudan plans to set up actions such as fiscal incentives and awareness campaigns.

Monitoring, verification and enforcement

The Sudanese Standards and Metrology Organization is responsible for verifying lighting product quality. There are testing laboratories within the National Center for Research, the Sudanese Standards and Metrology Organization, university laboratories, and the Center for Research and Industrial Consulting.

Environmentally sound management

No strategy or management plan has been reported.

5.4 Southern Africa

In southern Africa, countries have already taken important steps towards efficient lighting.

Lesotho

Regulatory mechanisms

[41] For other Northern African countries please refer to: UNEP en.lighten initiative (2011). Regional report on efficient lighting in the Middle East and North Africa". Retrieved on 29 November 2012 from: http://www.enlighten-initiative.org/portal/Portals/26107/documents/ConferenceMaterial/MiddleEast_NorthAfrica/Regional%20Report%20MENA%20Final.pdf

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

Through interviews, Lesotho expressed intentions to develop supporting policies and mechanisms to promote a transition to efficient lighting, though no supporting policies have been reported yet.

Monitoring, verification and enforcement

In the absence of any standards for the testing of efficient lighting, Lesotho adopted the South African Bureau of Standards guidelines for monitoring, verification and enforcement.

Environmentally sound management

The energy-saving lamps produced in Lesotho comply with strict European Union RoHS environmental standards and have a maximum mercury content of 3.5mg per lamp. A recycling plant is planned for construction next to the manufacturing facility and a policy for the disposal of lamps is in draft form.

Namibia

Namibia has already proceeded with the distribution of efficient lamps however, the market has not shifted towards energy efficient lighting products due to their high initial cost.

Regulatory mechanisms

In 2006, the Ministry of Mines and Energy published a report, the "Code of Practice and Register of Products for Namibian Solar Energy technologies," in which minimum criteria was identified for both CFL and LED lamps, such as lumens, lifetime and switching cycles. Currently there are no labeling and certification standards in Namibia. However, Namibian Standards Institution (NSI) is the most appropriate institute to assist in the adoption of standards and certification of lighting products.

Supporting policies

In 2007, NamPower, the national utility, launched a demand side management project under the auspices of the Ministry of Mines and Energy. The project analyzed regional and international trends and practices in demand side management and reviewed best practices for addressing electricity shortages. Two main areas of focus were identified:

- Consumer education through awareness campaigns
- Distribution of energy saving CFLs

Under this project, three CFLs were distributed in exchange for three inefficient incandescent lamps. An element of the awareness campaign is shown in**Erreur ! Source du renvoi introuvable.** Figure 12 below.

Figure 12. Poster for demand side management project in Namibia

Monitoring, verification and enforcement

Although NSI owns testing and inspection facilities, they are not used to test lamps or lighting products, and no monitoring, verification and enforcement measures have been reported

Environmentally sound management

No strategy or management plan has been reported.

South Africa

Comprising 44,100 MW, South Africa has the largest installed capacity in sub-Saharan Africa and is the most advanced in terms of implementing energy efficient lighting. The South African government recognized the need for energy efficiency in the residential sector and published the National Energy Efficiency Strategy (NEES) in 2005.

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been reported.

Supporting policies

The national utility, ESKOM, drives the large scale roll-out of energy efficiency demand side management programs. These focus on identifying and promoting more efficient ways to use electricity, through the implementation of technology enhancements and behavioral changes. Eskom follows a rigorous commercial process for all procurement. CFLs are purchased through open international tender that specifies the selection criterion such as availability, pricing and compliance with minimum tender specifications.

By the end of the 2011, over 47 million CFLs had been installed in the residential sector nationwide, reducing demand by 1,958 MW[42].

The South African strategy links energy sector development with national socio-economic development plans, and has set a target for improved energy efficiency in South Africa residential sector of 10% by 2015[43]. The South African state-owned electricity utility remains supportive of the carbon market as a tool to provide additional revenue and thus, bridge some of the cost gaps, as well as the wide-scale deployment, of low-carbon emitting technologies.

The distribution of CFLs occurred through a combination of door-to-door campaigns and exchange points. In addition to the reduced demand from residential sector, the project delivered significant socio-economic benefits through creation of 30,000 temporary jobs nationally.

[42] ESKOM. COP 17 fact sheet. Retrieved on 29 November 2012 from: http://www.eskom.co.za/content/Efficient%20Lighting%20Programme%20involving%20the%20rollout%20of%20Compact%20Fluorescent%20Lamps%20(CFLs).pdf

[43] Ibid.

Table 5. CDM projects in South Africa

Eskom CFL Programme	Number of CFLs distributed – estimated tonnes of CO_2 saved	Years of CFL distribution	Type of carbon credit accreditation	Current status	Future milestones
Historical roll-out projects	30 million CFLs - more than seven million tCO_2	2007-2010	GS large-scale VER project *(voluntary market)*	GS feasibility analysis	• Validation – February 2012 • GS accreditation – June 2012 • First VER issuance – September 2012
Greenfield projects	1.5 million CFLs – more than 300 000 tCO_2	2011	CDM small-scale projects *(compliance market)*	• Stakeholder consultation completed • Currently in CDM validation	• CDM registration mid 2012 • First issuance of CERs 2013
Sustainability projects	20 to 40 million CFLs – more than six million tCO_2	2011-2013	CDM programme of activities *(compliance market)*	• Stakeholder consultation completed • Currently in CDM validation	• CDM registration mid 2012 • First issuance of CERs 2013

Source: ESKOM COP17 fact sheet, ESKOM CFL CDM Project

Monitoring, verification and enforcement

The South African Bureau of Standards (SABS) has testing facilities and has developed standards, publications and references concerning lighting technologies. Among those used by ESKOM for the technical specifications for general lighting lamps are:

- SANS 62031 LED modules for general lighting – safety specification
- IEC/PAS 62612 – Self-ballasted LED-lamps for general lighting services – performance requirements
- SANS 60968 – Self-ballasted lamps for general lighting services – safety requirements
- SANS 60969 – Self-ballasted lamps for general lighting services – performance requirements

- SANS 50285 – Energy efficiency of electric lamps for household use – measurement methods
- VC 9091 – Compulsory specification for compact fluorescent lamps

Environmentally sound management

In 2008, a joint initiative from ESKOM, Western Cape and City of Cape Town, involved the design of a CFL recovery strategy. The document aims to provide guidelines to establish a 'recycling culture' in South Africa and to address the current lack of legislation and infrastructure to accommodate CFL recycling and disposal from domestic use. Some of the proposed activities include:

- CFL point-of-sale at retail locations were identified as the most practical choice to host collection points or act as drop-off centers.
- Create a legislative framework regarding mercury-containing waste management. There is no specific legislation for the disposal of CFLs except an indication that they must be disposed "in a controlled manner." The document lists a number of regulations for manufacturers, transporters and the public to be in compliance with environmental and waste management laws.

Swaziland

Regulatory mechanisms

The Energy Regulatory Act of 2007 established an Energy Regulatory Authority, which is tasked with enforcing compliance standards, approving tariffs and promoting economic efficiency in the energy industry[44].

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been implemented in Swaziland. However, the Government of Swaziland plans to implement MEPS and a labeling system for lighting products.

Supporting policies

The prohibitive price of CFLs in comparison to the price of incandescent lamps (approximately 5 times higher for comparable lumen output) compelled the Government of Swaziland to implement cooperative procurement to enable consumers to obtain efficient lighting.

The Swaziland Electricity Company (SEC) has been promoting the use of CFLs since 2001 through exhibitions and trade fairs where they have distributed hundreds of free CFLs. They

[44] Ministry of Natural Resources and Energy. Retrieved on 29 November 2012 from: http://www.gov.sz/index.php?option=com_content&view=article&id=283&Itemid=361

promote electricity savings methods on their website where they invite customers to switch inefficient incandescent lamps for CFLs.

The SAPP (Southern African Power Pool), to which Swaziland belongs, also plans to distribute CFLs and to take advantage of the economies of scale. SAPP utilities have indicated a need for about 40 million CFLs over the next three years (2009). Over and above the ELI specifications, SAPP has additional requirements to be met by the suppliers[45].

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

5.5 Western Africa

Benin

Regulatory mechanisms

In 2009, Benin launched "Benin Energy Efficiency Project" (BEEP). Part of this program aimed at setting up a labeling system for CFLs and air conditioning units in order to replace inefficient consumer electrical appliances with high quality products. The program has not implemented labels for lighting products.

Supporting policies

Subsidized by the GEF, BEEP aims at distributing 350,000 CFLs to reduce peak demand and reduce energy consumption. It also aims at promoting energy efficiency through capacity building, information and awareness building.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

[45] Southern African Power Pool (SAPP) (2009). A SADC Residential Compact Fluorescent Lamps Rollout Program. Retrieved on 29 November 2012 from: http://www.sapp.co.zw/docs/SAPP%20CFL%20Business%20Case_FEB%202009.pdf

Burkina Faso

In 2005, the Government launched "Le Projet de Développement du Secteur de l'Electricité", Electrical Sector Development Project (ESDP), financed by international organizations such as the World Bank, Nordic Development Fund, Agence Francaise de Développement, and European Investment Bank. Part of the ESDP aims at addressing issues relating to demand-side management and investments linked to demand-side management.

Regulatory mechanisms

Currently the country has no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products. Nevertheless, a plan to set up a labeling system through the West African Economic and Monetary Union framework is currently underway.

Supporting policies

Through the ESDP project, investments in energy efficiency have been made to encourage the use of energy efficient air-conditioners, reflective film to reduce thermal load in buildings, and energy efficient lighting. This has led to the installation of 32,800 efficient lamps.

Information and educational campaigns were also utilized to promote the effective use of electricity.

Monitoring, verification and enforcement

The country does not have any test methods for lamps to establish standards or labels but the *"Institut de Recherche Scientifique Appliquée et Technologique"* is a Burkinabe laboratory which has the capacity to test lighting products.

The country lacks the regulatory and policy structure to prevent unauthorized products being sold in the country.

Environmentally sound management

Though the country has initiated various programs to collect different types of electrical and electronic waste, no strategy or management plan for lighting products has been reported.

Cape Verde

Regulatory mechanisms

Currently the country has no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products.

Nevertheless, the Department of Energy is performing a study on energy efficient appliances sold in retail locations in order to develop regulations regarding energy performance. Regulatory discussions are in progress with the EU and there are plans to adopt EU regulations.

Supporting policies

Cape Verde distributed 250,000 CFLs, accompanied by promotional campaigns for community engagement in 2009, 2020 and 2011. The distribution program was financed by The World Bank.

Monitoring, verification and enforcement

Border control is the only activity that has been implemented to avoid unauthorized products from entering the country.

Environmentally sound management

Although some institutions have implemented waste sorting programs, no strategy or management plan for lighting products has been reported.

Côte d'Ivoire

Regulatory mechanisms

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been implemented to date.

International standards and specifications, designed under IFC/GEF Efficient Lighting Initiative were considered as an approach to be adopted for Côte d'Ivoire.

Supporting policies

At the beginning of 2012, Côte d'Ivoire launched a project entitled "Promotion of Energy Efficiency Lighting in Public, Commercial and Residential Buildings." The project includes the creation of an energy efficiency institutional and policy framework. Public awareness and consumer education initiatives will be undertaken for the rapid and thorough dissemination of energy efficient lighting technology information.

A strong focus is being given to CFL awareness, but this will evolve as other technologies, such as LED lamps, emerge. The retrofitting of street lights is also part of an improvement project to enhance business and commercial districts in selected towns. Additionally, the project also plans to equip public buildings with energy efficient lighting.

Monitoring, verification and enforcement

"Laboratoire National d'Essais, de Qualité, de Métrologie et d'Analyses" (LANEMA) will be responsible for testing energy efficient lighting products in order to formulate, adopt and enforce quality standards. Despite its status of reference laboratory, LANEMA needs to achieve capacity building in the testing of energy efficient lighting products.

Monitoring of the programs will be carried out by the utility Compagnie Ivoirienne d'Electricité (CIE) to assess the energy saved in participating areas and will periodic evaluations and reports.

Environmentally sound management

No strategy or management plan for lighting products has been reported.

The Gambia

The electricity access rate in Gambia has reached 30%. The average selling price of electricity for the residential sector is 9.1 D/kWh (around 0.28 $/kWh). There are no government subsidies for electricity however, urban consumers subsidize the cost of electricity for rural consumers. In this context, the government has identified the energy savings potential for CFLs. Depending on the quality, the cost of a CFL may be two to twelve times higher than the price of an inefficient incandescent lamp.

Regulatory mechanisms

Gambia has not established mandatory or voluntary standards, laws or regulations regarding the use of energy efficient appliances or lamps.

Supporting policies

In March 2008, the government of Gambia lifted the import tax on energy efficient and renewable energy technologies and appliances which has provided an impetus for energy efficiency. The Public Utility Regulatory Authority (PURA) replaced more than 2,000 incandescent lamps with CFLs in some areas. The Ministry of Energy, in collaboration with the Renewable Energy Agency, replaced 4,000 incandescent lamps with CFLs in the West Coast Region. The government will require additional support, as an estimated 700,000 incandescent lamps still need to be replaced.

The Ministry of Energy, through the support of the UNDP, embarked on a national awareness-raising campaign which involved the distribution of informative leaflets, radio discussions and promotional posters.

Monitoring, verification and enforcement

Plans are underway to establish a testing and certification centre to develop MEPS as well as to implement labeling and testing methods. Moreover, a law is about to be enacted to ensure that unauthorized products will not be sold in the country.

Environmentally sound management

No collection, recycling and disposal initiatives for lighting products have been reported. Some environmental laws concerning hazardous chemicals do exist concerning air and water quality standards and monitoring under the "Environmental Quality Standards Regulations" (1999).

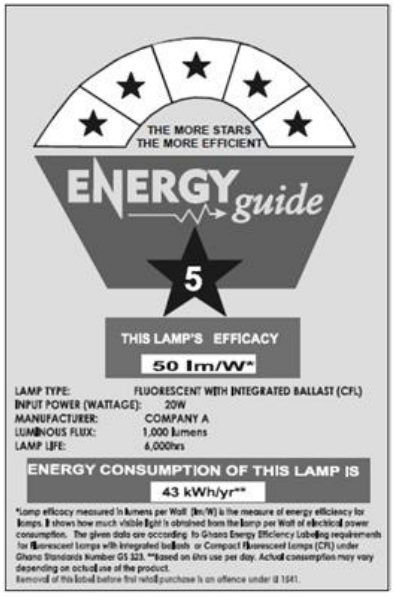
Ghana

Ghana is one of the most active countries in Africa in terms of implementing energy efficient lighting programs.

Regulatory mechanisms

The Government of Ghana implemented energy efficiency standards and labeling for household refrigeration appliances in 2008 and 2009. Recycling and disposal initiatives for lighting products are currently under development. An illustration of the labeling system in use in Ghana can be seen in Figure 13 below.

Figure 13. Labeling for lamps used in Ghana



Supporting policies

Since April 2003, the Government of Ghana has removed import duties and VAT on CFLs to make them affordable for consumers.

In 2007, the government of Ghana, led by the Energy Commission, distributed 5.9 million CFLs free to consumers in exchange for inefficient incandescent lamps. The entire program cost the government 15.5 million USD which was borne solely by the state. This resulted in peak savings of 124 MW and CO_2 savings of 112,320 tons per annum[46]. A survey conducted in 2009 revealed that CFL penetration had increased from 3% to 79% and the number of incandescent lamps in the market were reduced from 58% to 3%.

Monitoring, verification and enforcement

To verify compliance to MEPS, Ghana has a test facility installed at the Ghana Standards Authority. The test method is based on national standards. The standard, which concerns lighting systems and fluorescent lamps is GS 323: 2003 ”Lighting Systems - Self-Ballasted Lamps for General Lighting Services - Performance Requirements”.

To further protect consumers against counterfeit, sub-standard and unreliable CFLs, the Energy Foundation, Energy Commission and Ghana Standard Board, have introduced a Performance and Efficiency Standard for CFLs[47]. The official regulation (L.I 1815), applies to self-ballasted CFLs and was enforced beginning in 2005.Ghana, through the customs department and the Ghana Standard Authority, also control entry points so that unauthorized products are not sold in the country.

Environmentally sound management

The Energy Commission of Ghana commissioned a study on CFLs disposal that determined that 64% of the sample population surveyed experienced at least one incidence of broken CFLs and 75% of end users claimed no knowledge of mercury content in CFLs. However, no strategy or management plan for lighting products has been reported.

Guinea

Regulatory mechanisms

[46] Renewable Energy & Energy Efficiency Partnership (REEEP) (2012). Development of Energy Performance Standards and Labels for LED lamps for Renewable Energy and Grid Applications in Ghana.

[47] Ghana Energy Commission. Ghana Appliance Energy Efficiency Standards and Labelling Programme. Retrieved on 29 November 2012 from: http://new.energycom.gov.gh/downloads/General%20Documents/Ghana%20Appliance%20energy%20efficiency1.pdf

No regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been implemented to date.

Supporting policies

In order to promote energy efficiency, various efficient lighting programs have been initiated including:

- Economic Community of West African States (ECOWAS) program to replace 750,000 inefficient incandescent lamps with CFLs
- PAESE project to distribute 600,000 CFLs to Kaloum area, funded by The World Bank.
- ELSEWEDY project to supply 3,500,000 lamps, funded by BND (*Banque Nationale de Développement*)

In spite of efforts however, no CFLs have been distributed in Guinea to date. Free distribution or installment payments with on-bill financing have been discussed but a final strategy has not yet been determined. The distribution, whether free or against payment, will be backed with awareness raising, promotional and educational campaigns for end users.

The government of Guinea also plans to enforce energy efficiency through the creation of an energy budget fund that taxes appliances that are not energy efficient.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

Guinea-Bissau

Regulatory mechanisms

The country does not have any regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products in place.

Supporting policies

In 2012, the country submitted a request to ECOWAS for funding a project to distribute one million efficient lamps. The National Energy Company launched an awareness campaign on the benefits of energy savings, to encourage consumers to lower their energy consumption.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

Mali

Regulatory mechanisms

Mali initiated a project called "Projet d'appui au secteur de l'énergie" (PASE) in 2009. The program supports the national energy policy by improving the supply of energy services to reinforce the country's competitiveness. The objective of PASE is to assist in the progressive phase-out of inefficient incandescent lamps with a target date of 2020, as announced in the Strategy Development Paper from the African Development Bank (AFDB).

The project also intends to transform the appliance market, including refrigerators and air conditioners, towards energy efficient products.

Supporting policies

Among the various components of the ongoing PASE project, is the free distribution of 1 million efficient lamps[48]. Over 300,000 CFLs have already been distributed to households. For public demonstration purposes, the retrofit of 15,000 street lights has also been planned. An awareness raising campaign has been launched in order to mitigate the risk of a low penetration rate and includes; posters, flyers, information guides, TV and radio spots.

Disposal of the returned inefficient incandescent lamps is being considered in order to prevent the lamps from reappearing in the market.

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

[48] African Development Bank (2010). Stratégie de developpement de la maitrise de l'énergie au Mali. Retrieved on 29 November 2012 from: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Project-and-Operations/%C2%B2Mali%20-%20Strat%C3%A9gie%20de%20d%C3%A9veloppement%20de%20m%C3%AEtrise%20de%20l'%C3%A9nergie_02.pdf

Mauritania

Regulatory mechanisms

Although no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products have been implemented, efforts to establish MEPS and a labeling system are currently under development.

Supporting policies

The government of Mauritania is also in the process of conducting a tender for the procurement and distribution of 500,000 CFLs. In a public demonstration move and to confirm its commitment to energy efficiency, the government of Mauritania has replaced public street lighting with energy efficient street lamps.

Monitoring, verification and enforcement

In the absence of a national testing center, a university laboratory conducts research on efficient lighting products. This system can benefit the future establishment of test methods, MEPS and labeling systems.

Mauritania operates a control institute for all incoming products but does not restrict products through mandatory standards.

Environmentally sound management

No strategy or management plan has been reported, but a system for the collection and disposal of efficient lighting is expected to be adopted at a later date.

Niger

Regulatory mechanisms

Niger is a full member of ECOWAS and although ECOWAS has launched energy efficiency initiatives, there are currently no mandatory MEPS for the country. However, in accordance with ECOWAS and the West African Economic and Monetary Union, Niger plans to implement a labeling system for efficient lighting.

Supporting policies

Niger has not yet begun a program to phase-out inefficient lighting but a tender for the distribution of one million CFLs is in the draft stage.

Niger is also proposing the implementation of buildings codes and the free distribution of efficient lighting with an accompanying awareness campaign focused on energy efficiency.

Monitoring, verification and enforcement

There are no testing facilities in Niger and there are no plans to implement such a facility. Border controls are already in place to ensure that unauthorized products do not enter the country.

Environmentally sound management

No spent lamp treatment program exists, however, if the mass CFL distribution program succeeds, a lamp disposal facility could be established at a later late.

Nigeria

Nigeria has an installed stock of 240 million inefficient incandescent lamps in the residential sector out of the 600 million inefficient incandescent lamps in use among all sectors. Efficient lighting contributes to approximately 9 million units[49].

Regulatory mechanisms

Currently the country has no regulatory mechanisms, MEPS or labeling and certification standards for efficient lighting products.

There are plans to develop regulations for lighting products in collaboration with the UNDP and the GEF and to develop MEPS under the UNDP/GEF Energy Efficiency Project in Nigeria. Nigeria also has plans to implement a labeling system.

Supporting policies

A joint pilot project for the replacement of one million inefficient incandescent lamps has been developed between the Energy Commission of Nigeria, ECOWAS and the Republic of Cuba. The program was financed by the Nigerian government which purchased 500,000 CFLs. The Government of Cuba donated 500,000 CFLs.

Monitoring, verification and enforcement

There are two highly equipped laboratories in Nigeria, the Standard Organization of Nigeria (SON) Laboratory in Lagos and the SON Laboratory in Enugu. The Nigeria Industrial Standards also has a method for the testing of lamps. There is border and custom control to ensure that unauthorized products are not sold in the country, and investigations are carried out by the Consumer Protection Council if unauthorized imports are found.

Environmentally sound management

[49] Country questionnaire completed (06/09/2012) Mr. Ibrahim Soumaïla – Energy efficiency expert at ECREEE secretariat.

Consumers are properly informed about the safe of disposal of lamps through various media channels. A recycling process is anticipated to be implemented when the installation of CFLs in the country reaches a critical mass.

There is also legislation in place for electronic waste through the National Environmental Standards and Regulations Enforcement Act of 2007. The Act established "electronic waste and/or hazardous waste disposal regulation or any recycling program in Nigeria".

Senegal

Regulatory mechanisms

In January 2011, a decree was released banning the import and production of inefficient incandescent lamps and promoting energy efficient lighting[50].

Supporting Policies

Two programs have been launched in Senegal regarding sustainable lighting, one in rural areas and the other in grid-connected areas.

The first program was implemented by the Agence Sénégalaise d'Electrification Rurale – *Senegalese Rural Electrification Agency* (ASER), which is an autonomous public entity under Senegal's electricity Reform Law 98-29. Working under CDM, ASER launched a program in 2008 for the promotion of energy efficient CFL lamps in rural areas in Senegal[51] to promote energy efficiency in newly electrified households. This demand-side energy efficiency program is based on the installation of CFLs in newly electrified households and buildings in place of inefficient incandescent lamps.

The second program was part of the TAKKAL plan to rehabilitate the energy sector in Senegal with the objective of standardizing energy efficient lamps. The TAKKAL program, with the support of the national electrical utility, SENELEC, included the distribution of 3.5 million CFLs. The pilot phase, completed in 2009, consisted of distributing 500,000 CFLs in the outskirts of Dakar. A study was performed to analyze results and it was concluded that a demand reduction of 9 MW was achieved[52].

Efficient lighting products need to be imported into the country and are much more expensive than inefficient incandescent lamps. The market price for a good quality CFL lamp is

[50] Republique du Senegal Journal Officiel (2011). Retrieved on 29 November 2012 from: http://www.jo.gouv.sn/spip.php?article8800

[51] UNFCCC (2008). Promotion of energy-efficient lighting using compact fluorescent light bulbs in rural areas in Senegal. Retrieved on 29 November 2012 from: http://cdm.unfccc.int/filestorage/G/Q/E/GQE5YFLP9RZVKNDHCJS12TA7M6I83W/SSC_POA_DD_Senegal.pdf?t=ZUl8bWFhZ2RtfDDgd6M04QReICnVlEq6cSsV

[52] Republique du Senegal Journal Officiel (2011). Retrieved on 29 November 2012 from: http://www.jo.gouv.sn/spip.php?article8800

approximately 8 USD, a high initial investment for low income consumers in rural areas. Through bulk procurement can lead to rebates, the model promoted under this program, the price of a CFL can only be brought down to 6 USD, which is still significantly higher than the price of an incandescent lamp (less than 1 USD).

Besides financial barriers, the use of CFLs is limited in Senegal due to a lack of awareness among end users. Consumers do not completely realize the benefits of adopting efficient lighting, including the benefit of reduced of electricity bills.

Monitoring, verification and enforcement

While Senegal is awaiting the adoption of standards, the energy efficient lamps that are imported and the inefficient incandescent lamps that are produced locally (there is no efficient lighting production facility in the country) will have to conform with recognized international standards from reference organization such as the International Standards Organization (ISO) or International Electrotechnical Commission (IEC).

For the overall distribution, regulation will be carried out by an independent organization external to the current administration. This body will be given authority in order to ensure that the lamps imported or produced locally meet rigorous specifications.

Environmentally sound management

The implementation of a recycling plan for energy efficient lamps has been forecasted.

Sierra Leone

With no electricity interconnection and a 10% electricity access rate, Sierra Leone has not moved towards energy efficiency or efficient lighting. Most of the urban households use inefficient incandescent lamps for lighting whereas the majority of rural households use kerosene. Appliances used in households (refrigerators, deep freezers, air conditioners, etc.) are old, primaryily bought second-hand and are inefficient[53].

Energy constitutes a significant proportion of Sierra Leone's gross domestic product and a considerable percentage of household energy expenditure. Although the potential for energy efficiency is high, the price of a CFL is three times that of an incandescent lamp and represents a significant barrier.

The government recognized the need for energy policies and initiatives in order to modernize its economy, mitigate climate change and ensure energy security for sustainable development. In

[53] United Nations Economic Commission for Africa (UNECA) (2004). The energy policy for Sierra Leone. Retrieved on 29 November 2012 from: http://www.uneca.org/eca_resources/conference_reports_and_other_documents/sdd/cemmats_study.pdf

May 2004, under the guidance of the Ministry of Energy and Power, "Energy Policy for Sierra Leone" was introduced to help the government formulate an appropriate energy policy and undertake key actions for the short and medium term. In November 2006, another report from the Ministry of Energy and Power was released, addressing the issues, objectives, strategies and policy goals for the energy sector in Sierra Leone.

Regulatory mechanisms

Although CFLs are sold in Sierra Leone, MEPS and maximum mercury levels for lamps have not been established. However, in accordance with its energy policy goal, the country plans to develop regulations to establish MEPS and a labeling system for efficient lighting.

Supporting policies

The government has not yet initiated supporting policies in the country. This has resulted in insufficient awareness among end users, as there are no efforts made to promote energy efficiency[54].

Monitoring, verification and enforcement

No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

No strategy or management plan has been reported.

Togo

Togo faces an acute electricity supply shortage, even though only 25% of its population is connected to the grid. Togo imports nearly 90% of its electricity from neighboring countries. Therefore, it is imperative that electricity consumption be reduced. In Togo, low quality CFLs are priced approximately three times higher than inefficient incandescent lamps[55].

Regulatory mechanisms

[54] United Nations Economic Commission for Africa (UNECA) (2004). The energy policy for Sierra Leone. Retrieved on 29 November 2012 from: http://www.uneca.org/eca_resources/conference_reports_and_other_documents/sdd/cemmats_study.pdf

[55] UNFCCC (2006). Project Design Document (PDD) for Togo CFL distribution project. Retrieved on 29 November 2012 from: http://cdm.unfccc.int/filestorage/O/N/8/ON84THN7JDDFNATNZY992NV2UKF4XD/PDD.pdf?t=Wjd8bWU3azRyfDCkMwXfGSwdNzaydKLhmrDr

In 2009, the "Emergency Infrastructure Rehabilitation and Energy Project" was approved by The World Bank. This project includes the "Togo Efficient Lighting Program" aimed at market transformation for CFLs through the introduction of energy efficiency standards, consumer awareness campaigns and CFL bulk procurement.

Togo has not yet established MEPS however, some performance standards, based on national conditions, have been set that require a long lifetime of 20,000 hours and high number of switching cycles for CFLs. There are still no national policies or legal regulations that require the usage of efficient lighting by consumers or an overall ban on inefficient incandescent lamps.

Supporting policies

A CFL distribution project which aims to distribute one million lamps (utilizing carbon financing), is at the validation stage. Additionally, the "Emergency Infrastructure Rehabilitation and Energy Project" program, supported and funded by the GEF, stresses reservations about consumer awareness, and the financial incentives required by consumers to make the switch[56]. To prompt consumers to adopt an energy efficient lifestyle, the national electricity utility, CEET, advertises in newspapers and magazines. It provides advice on simple acts to save electricity and encourages the use of low consumption bulbs[57].

Following the CDM process, a monitoring, processing and reporting plan has been expanded to measure energy savings and greenhouse gas emission reductions. These monitoring, verification and enforcement activities include: the necessity for households to fill out a form during distribution; the direct replacement of inefficient lamps with CFLs; the disposal of inefficient incandescent lamps; the destruction of collected incandescent lamps; and the monitoring of the actual lifetime of the CFLs distributed.

Monitoring, verification and enforcement

Togo does not have a testing laboratory. No monitoring, verification and enforcement measures have been reported.

Environmentally sound management

Currently, all fluorescent lamps used in Togo in commercial and residential applications are disposed of with the regular waste in landfills. However, as stated in the CDM description document, CEET will implement a mitigation plan that will address the issue of mercury.

[56] Global Environemnt Facility (GEF) (2009). Scientific and Technical Advisory Panel (STAP). Retrieved on 29 November 2012 from: http://www.thegef.org/gef/sites/thegef.org/files/repository/STAP%20review%203880.pdf
[57] Le Liberal, Hebdomadaire Togolais d'Information, d'Analyse et d'Opinion N°088, Wednesday, the 5th of September 2012.

6. Main findings and recommendations

Though very few countries in sub-Saharan Africa have effectively moved toward the phasing out of inefficient lighting, these national case studies demonstrate a wide range of situations and levels of complexity of the various initiatives. Although progress is disproportionate, the main findings are as follows:

- The transition to efficient lighting is increasingly considered as a key component of energy policies. Many countries are contemplating the implementation of policies to phase out incandescent lamps.
- There has not been a significant trend for a market led transition to efficient lighting, although there are some cases where carbon financing has been used as an effective tool. The removal of financial barriers is also critical to achieve a transition to efficient lighting in the region.
- Most countries need support to make progress towards implementing efficient lighting programs.
- Countries which are in the advanced stage of embracing energy efficient lighting technology still require further efforts to adopt an integrated policy approach.

6.1 Strengths and weaknesses

Assests

Positive impact for end users and public authorities

Efficient lighting can make a very positive impact on the electricity sector. For instance, in Chad, the transition to efficient lighting can save one-third of annual subsidies of CFA 8 billion per annum. Similarly, in Ghana, 124 MW of peak load was reduced with an investment of 16 million USD (the purchase of the efficient lamps).

The propagation of efficient lighting is one of the most cost-effective courses of action that can be taken and the quickest way to address the energy efficiency issue with the lowest capital investment.

For consumers, efficient lighting can play a vital role in terms of energy and financial savings, provided the appropriate awareness level is created.

In terms of addressing demand-side management, from the perspective of the utilities, energy efficient lighting systems play a critical role in the improvement of electricity distribution through peak shaving.

Wide social acceptance

Surveys and studies have demonstrated that there is social acceptance for energy efficient lighting programs. With the elimination of financial barriers and the implementation of awareness campaigns aimed at appropriate target groups, a massive migration towards efficient lighting technologies is anticipated. The survey conducted in Senegal after the distribution of 500,000 CFLs in Pikine concluded that over 95% of users were willing to adopt efficient technology.

Successful pioneering initiatives

The countries that have taken the lead to transition to efficient lighting show the region that efficient lighting is within reach. Best practices in terms of policies, regulations and program management can be shared among countries and successful models could be replicated within other sub-Saharan countries. Barriers could also be highlighted so that they can be avoided during the development and implementation of programs.

Limitations

Limited political awareness

The lack of political awareness and willingness to implement energy efficiency initiatives discourages the implementation of large-scale, energy efficient lighting programs.

Lack of capacities

While most countries lack standards, those countries that have established standards lack the capacity to expand and implement them. Capacity building would help develop MEPS and labeling standards. Enforcement mechanisms should be strengthened too.

Absence of local production

With the exception of Ghana and Lesotho, there is no efficient lighting production facility in sub-Saharan Africa. This situation forces public and private stakeholders to import efficient lighting and the absence of local production hampers the expansion of efficient lighting in the region.

Lack of a supporting incentive structure

The majority of countries in the region do not have strong incentive structures, and the lack of financial incentives is a major barrier for investments from both the public and private sector.

Absence of metering systems

In some countries, the absence of electrical metering systems means that consumers are not motivated to save energy by using efficient lamps . Without adequate metering systems and a transparent billing process in place, consumers will not be convinced about financial gains from efficiency.

6.2 Recommendations

Countries in sub-Saharan Africa may aspire to different types and levels of efficient lighting activity. To ensure that the transition to efficient lighting is effective and self-sustaining, a cohesive set of national and sub-regional actions needs to be designed and implemented, to include:

1) **Minimum Energy Performance Standards (MEPs)** - regulatory measures specifying minimum efficiency levels acceptable for products sold in a particular country or region. MEPS define which products can be marketed and those that should be eliminated. MEPS are the foundation from which to ensure the success of any efficient lighting transition plan. Countries should define the parameters, stringency and implementation period. Performance standards should specify the maximum permissible energy consumption limit for a given lumen output, or the minimum efficacy that a product must meet. Additional lighting quality guidelines may be stipulated , for example, rated lifetime, lumen maintenance and correlated color temperature. MEPS legislation includes or refers to product labeling requirement.

   MEPS should be based on national and regional conditions while taking into account global activity and technology evolution. The UNEP en.lighten initiative can analyze MEPS to assist countries to establish the harmonized levels and reduce the possibility of incompatible approaches. Such harmonization and cooperation helps to (1) prevent the development of a patchwork of different standards and labels, (2) reduce the costs of implementing labelling programmes for manufacturers and importers and (3) reduce non-tariff trade barriers.

Table 6. Suggested Actions for Countries Relating to MEPS Activities

Subject	Minimum Energy Performance Standards (MEPs)
Activities	Development of technology-neutral MEPS for non-directional household lamps harmonized across all sub-Saharan African countries
Actions for countries with no MEPS activities	• Evaluate the status of the lighting market, including the availability of efficient products • Consider what neighboring or similar countries have or plan to adopt for MEPS • Conduct economic analysis to determine net national benefits from migrating to efficient lighting
Actions for countries with	• Evaluate the progress on MEPS for lighting

some MEPS activities underway or planned	• Consider harmonizing MEPS with other countries • Study supply chains to ensure appropriate and compliant products are available in national markets
Actions for countries with many or intensive MEPS activities underway or planned	• Consider adding additional classes of lighting products • Review existing MEPS requirements and consider more ambitious levels • Coordinate lighting regulations with building energy code requirements

2) **Supporting Policies and Mechanisms -** in order to ensure the effectiveness and smooth implementation of MEPS for on-grid lighting technologies and the promotion of efficient off-grid lighting solutions, a range of complementary policies and measures are available. The success of the transition to efficient lighting will depend, in part, on the selection and combination of complementary policies on a national level based on a country conditions and circumstances and when possible, on a sub-regional level, including:

- Economic and market-based instruments: market mechanisms that are often initiated and promoted by regulatory incentives but can contain elements of voluntary action or participation. For example bulk purchasing and distribution; on-bill financing; and energy service performance contracting.

- Fiscal instruments and incentives: mechanisms that impact prices such as taxes aimed at reducing energy consumption; tariffs that encourage a strong selection of high performance products in the market; or financial incentives to overcome initial costs.

- Information and voluntary action: initiatives that persuade end users to change or modify their behavior by providing relevant information and examples of successful implementation. For example awareness raising, promotional and educational campaigns; certification and labeling programs; and public leadership and demonstration campaigns.

Table 7. Suggested actions for countries relating to supporting policies

Subject	Supporting Policies and Mechanisms
Activities	Development of mandatory labeling and certification for non-directional household lamps Cooperative procurement and distribution through a rebate or a

	giveaway programme for efficient lamps Development of the following optional systems (chosen on a national basis) for efficient lighting products: • On-bill financing • Subsidies • Tax increases • Awareness raising, promotion and education
Actions for countries with no supporting policies	• Education and awareness campaigns for consumers • Demonstration of efficient technologies • Examine tariff structure for imports of efficient technologies
Actions for countries with some supporting policies underway or planned	• Establish financing methods to make efficient technology available to all users • Facilitate bulk procurement of efficient lighting • Harmonize tariff structure for imports of efficient technologies with nearby countries
Actions for countries with many or intensive supporting policies underway or planned	• Consider government support for economic development related to lighting manufacturing and the provision of energy efficiency services

3) **Monitoring, Verification and Enforcement** - the success of a transition to efficient lighting depends heavily on a well-functioning system of monitoring, control, and testing facilities capable of ensuring enforcement and full compliance with MEPs. Unless effective and timely market surveillance systems are enforced on regional and national levels, substandard products will continue to enter markets in increasing numbers, reducing energy and financial savings. Poor quality products may also create unfulfilled expectations and disappointment on the part of end users who will refrain from purchasing these products on an ongoing basis in the future. Additionally, they ensure that government regulators fulfill the objectives of their efficient lighting initiatives. The same activities also protect suppliers by ensuring that each manufacturer is subject to the same program entry conditions. Monitoring, verification and enforcement (MVE) activities encompass a wide range of actions:

- Monitoring is a measurement process to verify product efficiency
- Verification is the measurement process through which declarations of conformance by lighting suppliers are confirmed

- Enforcement is the action taken by program administrators or other responsible parties against suppliers of non-compliant products

To enhance the monitoring, verification and enforcement capacity of various countries, the sharing of information and skills between countries across the sub-regions provides an effective means through which to promote best practice quickly and thoroughly. Sub-regional cooperation for enforcement through the sharing of test capacities, programs and test data is highly recommended for conducting cost-effective and efficient monitoring, verification and enforcement activities.

Table 8. Suggested actions for countries relating to MVE activities

Subject	Monitoring, Verification and Enforcement
Activities	• Develop a harmonized monitoring system with a centralized database • Establish harmonized test standards • Establish and/or enhance lighting test laboratories capable of verifying compliance with MEPS • Enforce harmonized measures in case of non-compliance
Actions for countries with no monitoring, verification and enforcement activities	• Establish a market baseline for lighting • Track volume and quality of lighting imports, gather importation documentation and manufacturer test reports • Investigate potential for testing lamps regionally
Actions for countries with some monitoring, verification and enforcement activities underway or planned	• Establish a national registry for lighting products, gather importation documentation including disclosure of performance • Establish links with regional testing laboratory facilities • Assess test methods used by facility, including relevant IEC standards for lighting products
Actions for countries with many or intensive monitoring, verification and enforcement activities underway or planned	• Set up a market surveillance system with provisions for random sampling and testing • Establish and clearly communicate penalties for non-compliance • Establish a national testing laboratory, support accreditation to latest IEC standards for lighting technologies

4) **Environmentally Sound Management** - from a life-cycle perspective, phasing out inefficient incandescent lamps or kerosene lamps and replacing them with efficient lighting reduces CO_2 emissions and mercury pollution from fossil fuel burning. However,

because CFLs contain mercury and LED lamps should be treated as electronics, a more integrated policy approach is required, one that follows the principles of pollution prevention and environmentally sound management. This approach includes establishment of harmonized maximum mercury and other hazardous substance content standards in line with global best practices and the development of a legal framework for environmentally sound management activities.

It is important to ensure the availability of quality lamps in the market; verifying their compliance with maximum mercury limits is essential to minimize health and safety risks. Policy and legislation should be carefully drafted and implemented for collection channels and recycling facilities. These recommendations reflect global international initiatives addressing hazardous waste including "Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal," and the "Intergovernmental Negotiating Committee" for the development of a legally binding agreement on mercury. The establishment of sub-regional collection and recycling systems could be an alternative if national approaches are not financially viable to support the recycling of lamps in one single country. However, a regional approach would require careful planning and bilateral agreements between the countries.

Table 9. Suggested environmentally sound management practices

Subject	Environmentally Sound Management Practices
Activities	• Establish harmonized maximum mercury levels in CFLs • Establish national collection systems for spent lamps • Establish recycling and disposal facilities for spent lamps • Implement educational campaign on the importance of recycling and ways to handle a broken CFL
Actions for countries with no environmentally sound management activities	• Education and awareness campaign for waste collectors and for consumers • Investigation into logistics model to facilitate recovery and recycling of lighting products
Actions for countries with some activities underway or planned	• Consider a financial system (e.g., trade-in scheme) to incent the collection of spent lighting products • Establish locally appropriate voluntary or mandatory recycling
Actions for countries with many or intensive activities underway or planned	• Develop and implement regulations on maximum allowed mercury levels in CFLs • Establish a mandatory recovery and recycling system • Expand programmea to ensure all lighting products are included, especially fluorescent lamps and ballasts.

The methodology presented above is based on a bottom-up approach, in which countries will decide individual levels of harmonization and the activities that are more logical and cost-effective to conduct on a regional level. Each country should determine how these priorities fit within their national context.

Country self-evaluations may point to opportunities for cooperation with international and bilateral agencies on proposals for financing, implementing and establishing lighting efficiency resources within sub-Saharan Region.

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http://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=48074

Appendix 1. Lighting Questionnaire for Sub-Saharan African Countries

1. Electricity

1.1. Please provide indications on Power Plants:

Type (Hydro, Oil, Coal …)	Location	Year of comissioning	Installed Capacity (MW)	Electricity Produced in 2009 (GWh)	Electricity Produced in 2010 (GWh)	Electricity Produced in 2011 (GWh)

1.2. Please also provide information on Power Plants, from renewable energies and others, which [country name] plans to build:

1.3. Does [country name] export or import electricity? If so, please indicate how much:

	Exports (GWh)	Imports (GWh)
2009		
2010		
2011		

1.4. What is the annual electricity consumption in [country name]?
2009 GWh
2010 GWh
2011 GWh

1.5. What is peak load?
2009 MW
2010 MW
2011 MW

1.6. Please provide an estimate of the breakdown of electricity consumption by sector (2010):

Residential sector (all houses, apartments, flats, etc., all end-use applications): %
Commercial sector (Offices, Retail, Schools, Hotels, Hospitals, etc.): %
Industrial sector (manufacturing and production facilities): %
Outdoor sector (street and pedestrian lighting): %

1.7. What is the electrification access rate (% of population) in [country name]?
%

1.8. How many people live in a typical household and what is the average electricity consumption per household per year (kWh)?

Average people per household: people

Average electricity consumed per household: kWh /yr

1.9. What are the estimated electricity grid losses (in %):

1.10. What is the estimated annual growth of electricity demand?

1.11. What is the frequency and number of electricity cuts:

1.12. Can you please provide a daily electricity demand curve:

1.13. What is the estimated cost of production of electricity?

average [currency]/MWh

at peak load [currency]/MWh

1.14. What is the average selling price of electricity per kilowatt hour in [local currency]?

Residential Sector (Households): (Local currency/kWh)

Commercial Sector (Offices, Retail, Schools, Hotels, Hospitals, etc.): (Local currency/kWh)

Industrial Sector (manufacturing and production facilities): (Local currency/kWh)

Outdoor Sector (street and pedestrian lighting): (Local currency/kWh)

What is the amount and type of subsidies to electricity?

2. Lighting

2.1. Please provide data on the various lamp types below for the most recent year available. Please provide either an estimate of the annual sales OR the installed stock of each lamp type. Please indicate whether the values below are sales or stock.

	Residential Sector	**Commercial Sector**	**Industrial Sector**	**Outdoor Sector**	**TOTAL**
Incandescent Lamps					
Volume					
Most common wattages:					
Halogen Lamps					
Volume					
Most common wattages:					
Compact Fluorescent Lamps (CFL)					
Volume					
Most common wattages:					

Linear Fluorescent Lamps					
Volume					
Most common wattages:					
High Intensity Discharge (HID) Lamps					
Volume					
Most common wattages:					
Light Emitting Diode (LED) Lamps					
Volume					
Most common wattages:					

2.2. What is the cost of a typical lamp? Indicate the cost (in your currency) and the wattage (W)

Incandescent Lamp	[local currency]	W
Halogen Lamp	[local currency]	W
Compact Fluorescent Lamps (CFL)	[local currency]	W
Linear Fluorescent Lamps	[local currency]	W
High Intensity Discharge (HID) lamps	[local currency]	W
Light Emitting Diode (LED) lamps	[local currency]	W

2.3. How many hours are lamps typically used in each of the sectors?

Residential	hours per day
Commercial	hours per day
Industrial	hours per day
Outdoor	hours per day

2.4. Do you know the proportion of electricity consumed for lighting in [country name]?

MWh or %

2.5. Are there lamp manufacturers or assemblers in your country? (YES or NO) . If yes, please specify the name of the company or companies, and the estimated production capacity per year:

2.6. We have a few general questions about households who use off-grid lighting:

Which fuel-based light sources are used (e.g., candles, kerosene)?

How much do these cost (approximately, in [local currency])?

Type of off-grid lighting device	Cost of 1 unit , in [local currency]
Candle	
Battery lamp	
Battery for a battery lamp	
Kerosene lamp	

Other:	

What is the price of 1 liter of kerosene, in [local currency]?

What is the amount of subsidies per liter of kerosene, in [local currency]?

How much / many of these would a typical household consume in a month?

Type of off-grid lighting device	monthly consumption
Candles	
Batteries	
Kerosene liters	
Other:	

2.7. Is there a refinery in [country name]? If yes, what is its capacity (barrels / day)?

3. Minimum Energy Performance Standards (MEPS) - Mandatory

3.1. Is there any law or regulations in place in your country establishing the MEPS for lighting products in the country? (YES or NO). If YES, please specify the name, the number of this legal document, timelines, technology specifications and provide a copy of any documentation, if possible.

3.2. Do these MEPS include a maximum mercury level for CFLs and/or Linear Fluorescent lamps? (YES or NO). If YES, please specify the maximum level of mercury for each type of CFL and/or Linear Fluorescent lamps sold in your country:

3.3. Do you have any plans to develop regulations to establish or improve MEPS for lighting products? (YES or NO). If YES, please describe these plans:

3.4. Are you aware of any laws or regulations in place for other electronic appliances , which establish the MEPS? If YES, please indicate the electronic appliances:

4. Labeling and Certification

4.1. Is there a labeling system for lighting products in place in your country? (YES or NO) If YES, please specify whether it is mandatory or voluntary, which technologies it covers and which institution is responsible for this.

4.2. If NO, do you have plans to implement labeling?

5. Supporting policies and mechanisms to promote the transition to efficient lighting

5.1. Have you already implemented any programs to replace inefficient incandescent lamps with more energy efficient light sources (e.g. CFLs, LEDs etc.)? (YES or NO). If YES, please check the nature of program in the list below:

- ☐ Energy codes for buildings
- ☐ Mandatory labeling and certification
- ☐ Voluntary labeling and certification
- ☐ Energy service performance contracting
- ☐ Installment Payments (On-bill financing)
- ☐ Cooperative procurement
- ☐ Giveaways
- ☐ Rebates
- ☐ Subsidies
- ☐ Taxation incentives
- ☐ Awareness raising, promotion and education
- ☐ Public leadership and demonstration

5.2. Please briefly describe the name of the program(s), the timeline for implementation, and the details of the programs indicated above (e.g. type of program, how the program was financed, how much was invested, how much of the investment is left etc.)

5.3. If NO, are you planning on developing any of the programs described above to replace inefficient incandescent lamps with efficient lamps? (YES or NO).

6. Monitoring, verification and enforcement

6.1. Are there any laboratories in your country that test lamps or lighting products? If so, how many and what are their capabilities?

6.2. Does your country have any test methods for lamps (e.g. National standards, IEA, Energy Star, Eco Label etc.)? If so, for which lamps, how are they developed, and what is their scope?

6.3. How do you ensure that unauthorized products (either because they do not meet the minimum legal performance requirements during verification tests or because they have not yet been tested) are NOT commercialized in the country? (e.g. border and customs controls, investigations, etc.).

7. Environmental issues

7.1. Are there any end-of-life collection, recycling and disposal initiatives for lighting products in your country? If YES, please provide a short description of these initiatives:

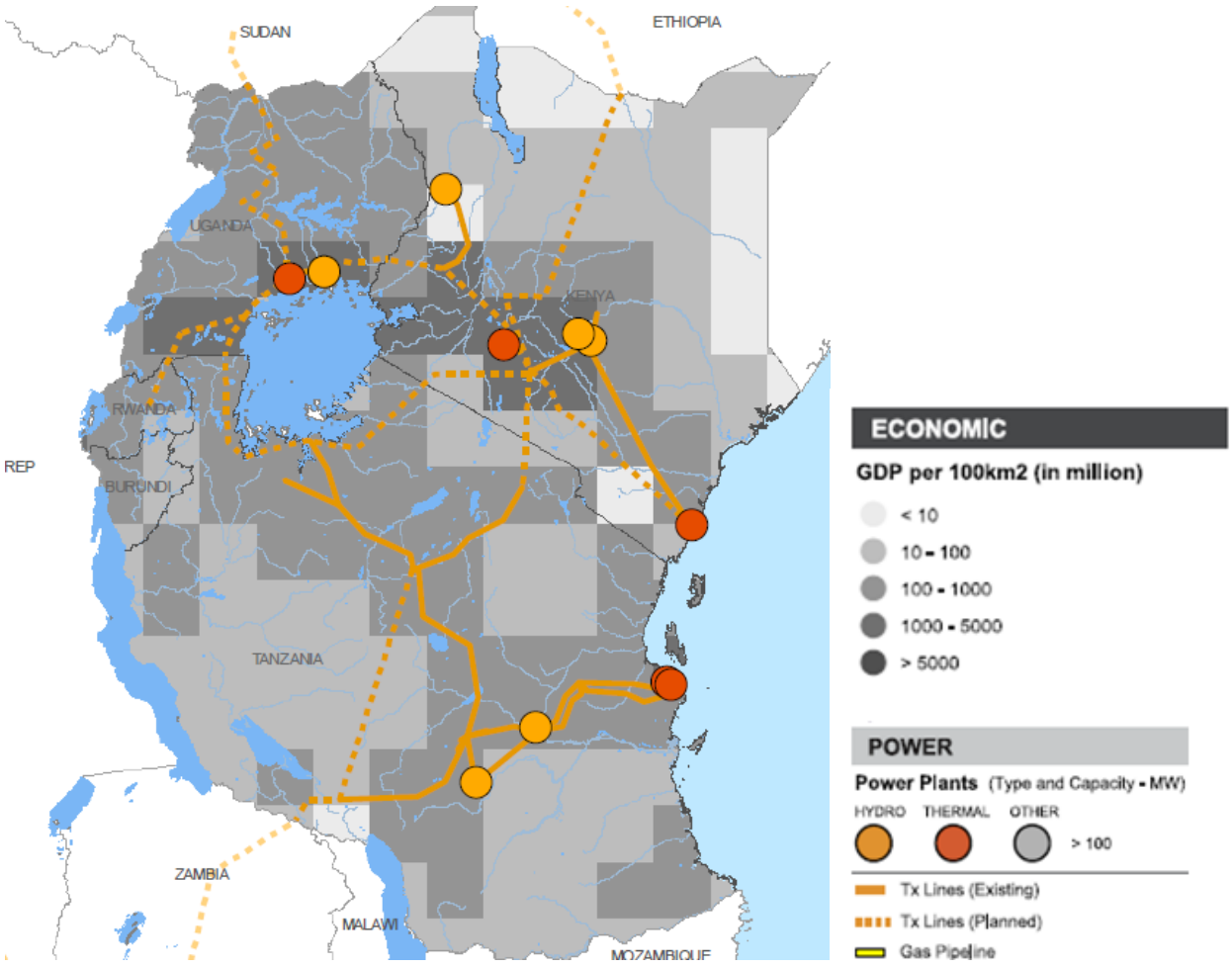
7.2. Is there legislation in place in your country for electronic waste and/or hazardous waste disposal or any recycling program in place in your country (e.g. recycling of glass, plastic, hazardous waste, etc.)? If Yes, please provide a short description of these initiatives:

7.3. If NO, do you have any plans to develop collection and recycling initiatives for CFLs or other types of lamps in your country? (YES or NO). If Yes, please describe these plans including timelines and agencies involved in the process:

8. Additional Information

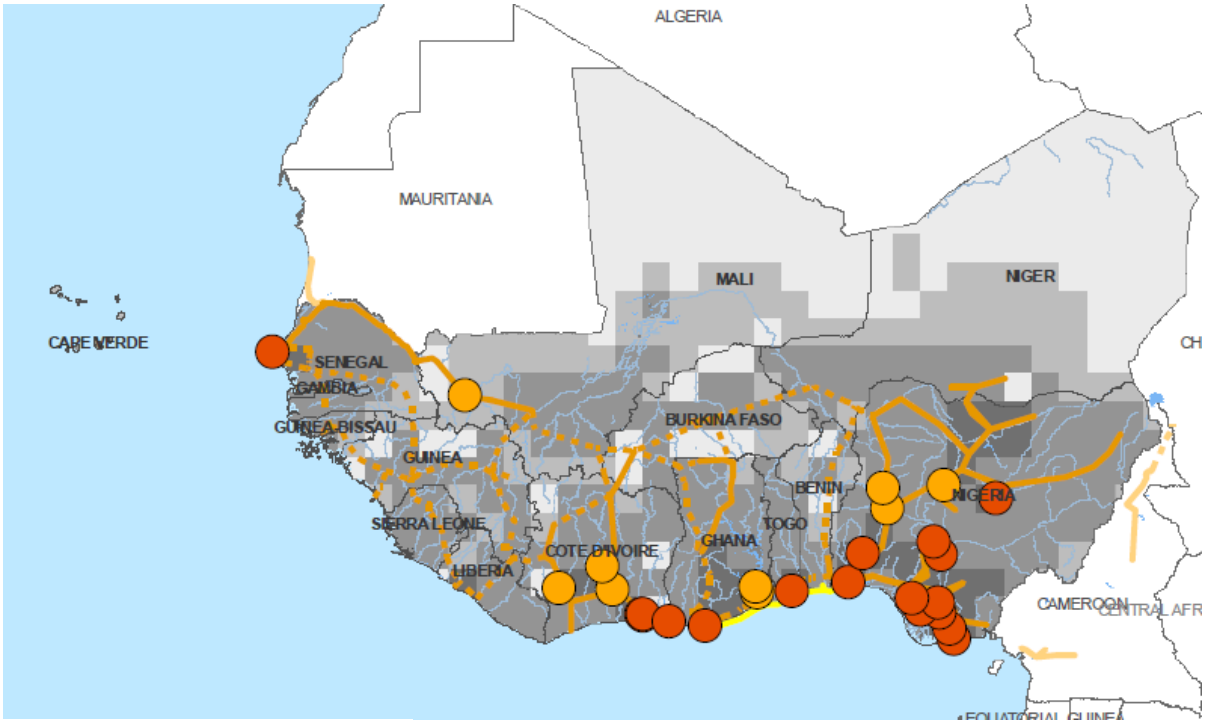
Appendix 2. Maps of Regional Power Grids[58]

East African Community



[58] African Development Bank (2011). Africa Infrastructure Country Diagnostic: Interactive Maps. Retrieved on 29 November 2012 from http://www.infrastructureafrica.org/aicd/documents/tools/list/interactive-pdf-maps

Economic Community of West African States



ECONOMIC

GDP per 100km2 (in million)

- < 10
- 10 - 100
- 100 - 1000
- 1000 - 5000
- > 5000

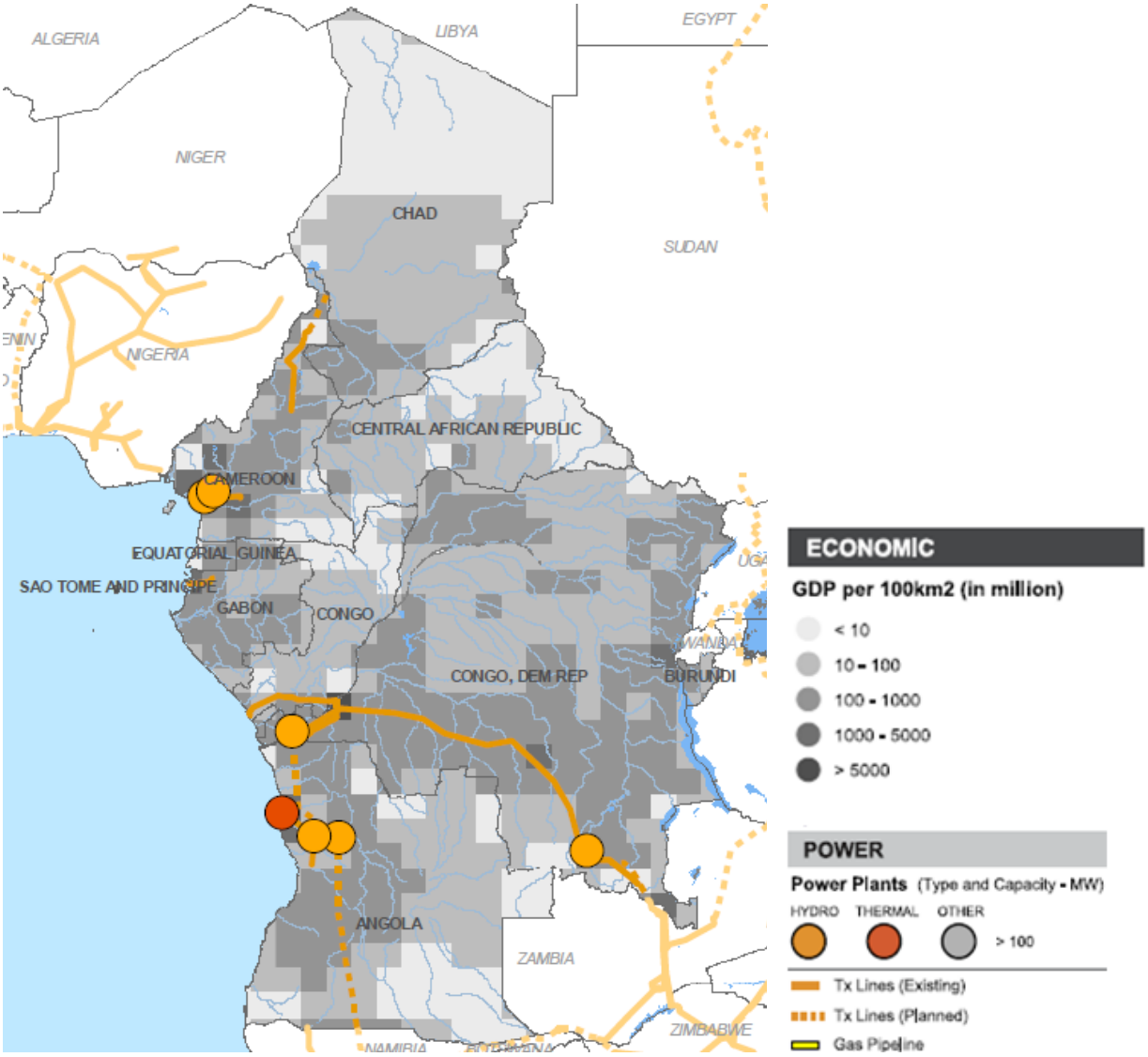
POWER

Power Plants (Type and Capacity - MW)

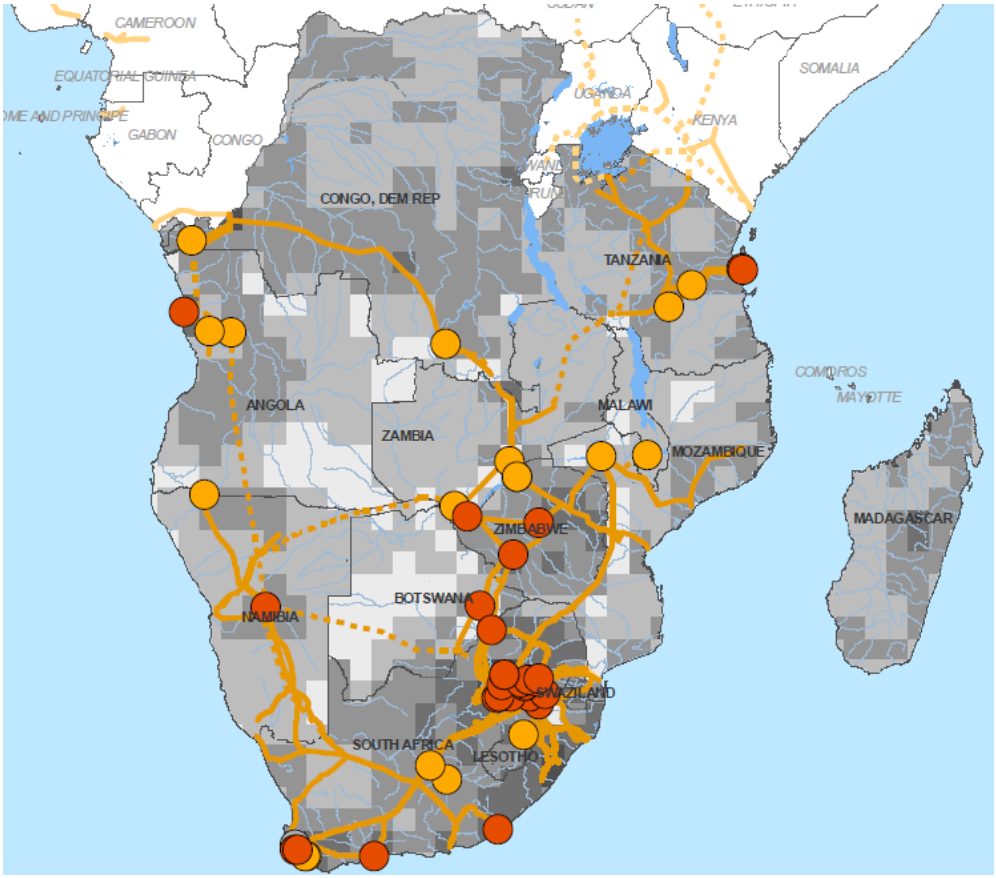
HYDRO THERMAL OTHER > 100

- Tx Lines (Existing)
- Tx Lines (Planned)
- Gas Pipeline

Economic Community of Central African States



Southern African Development Community



ECONOMIC

GDP per 100km2 (in million)

- < 10
- 10 - 100
- 100 - 1000
- 1000 - 5000
- > 5000

POWER

Power Plants (Type and Capacity - MW)

HYDRO THERMAL OTHER > 100

- Tx Lines (Existing)
- Tx Lines (Planned)
- Gas Pipeline

Appendix 3. Reported Trade of Lighting Products in Sub-Saharan Africa

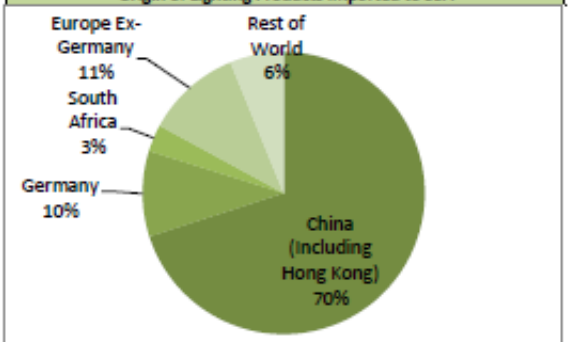
Imports of Lighting Products by Country - As Reported by Exported Country

Country	Imports per Year (USD)[1]	Per Capita /YR (USD)[1]
Angola	8,430,897	0.44
Benin	1,637,531	0.19
Burkina Faso	319,781	0.02
Cameroon	1,921,847	0.10
Cape Verde	464,604	0.94
Central African Rep.	52,495	0.01
Chad	122,076	0.01
Côte d'Ivoire	3,037,872	0.15
Dem. Rep. of the Congo	1,959,639	0.48
Ethiopia	3,730,215	0.04
Gabon	904,817	0.60
Gambia	141,290	0.08
Ghana	14,721,638	0.60
Guinea	593,168	0.06
Guinea-Bissau	25,303	0.02
Kenya	4,905,318	0.12
Lesotho[2]	964,784	0.44
Madagascar	1,091,973	0.05
Malawi	862,231	0.06
Mauritania	290,975	0.08
Mauritius	1,996,774	1.54
Mozambique	3,078,262	0.13
Namibia[2]	150,074	0.07
Niger	233,047	0.02
Nigeria	46,229,341	0.29
Rwanda	430,240	0.04
Senegal	1,731,604	0.14
Seychelles	186,951	2.16
Sierra Leone	163,121	0.03
South Africa[2]	81,557,104	1.63
Sudan	7,955,372	0.18
Swaziland[2]	21,222	0.02
Togo	568,161	0.09
Uganda	833,699	0.02
United Rep. of Tanzania	3,831,161	0.09
Zambia	1,875,206	0.14
Zimbabwe	2,262,978	0.18
Sub Saharan Africa - Total	**199,282,772**	**0.25**

Imports of Lighting Products by Country of Origin - As Reported by Exported Country

Country of Origin	Imports per Year (USD)[1]	%
China	138,152,548	69.3%
Germany	19,568,852	9.8%
South Africa[2]	6,190,091	3.1%
Netherlands	5,092,668	2.6%
Hungary	4,082,400	2.0%
Portugal	3,571,397	1.8%
Indonesia	2,471,197	1.2%
France	2,331,982	1.2%
United Kingdom	2,131,109	1.1%
India	1,756,893	0.9%
Rest of World	13,933,633	7.0%
Sub Saharan Africa - Total	**199,282,772**	**100%**

Origin of Lighting Products Imported to SSA



Export of Lighting Products within the Region

Top Regional Exporting Countries	Average Yearly Exports (USD)[1]	Primary Destination(s) in the SSA Region
South Africa	6,190,091	Zimbabwe, Zambia, Mozambique, Malawi, Dem. Rep. of Congo, Angola, Tanzania, & Nigeria
Namibia	523,827	Angola
Zambia	122,720	Dem. Rep. of Congo
Kenya	83,937	Rwanda & Sudan

[1] Averages are taken over the period 2007 to 2011.
[2] Denotes South African Customs Union (SACU) member and therefor there is no reporting trade of lighting products between the member countries.
Source Data: UN Comtrade (comtrade.un.org)

UNEP en.lighten initiative disclaimer: All trade data is as reported in the UN Comtrade database. Please note reported trade may differ from actual trade and input errors may cause discrepancies