CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 02 - in effect as of: 1 July 2004)

CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

Mandatory Energy-Efficiency Standard for Room Air Conditioners in Ghana

A.2. Description of the project activity:

The project developers will work with the Government of Ghana to develop and implement a mandatory Energy Efficiency Standard for Room Air Conditioners to an Energy Efficiency Ratio (EER) of 2.8 watts of cooling per watts of electricity. The mandatory standard will increase the average efficiency of the population of room air conditioners over the business as usual scenario. By improving the efficiency of the population of room air conditioners, there will be less electricity required to run the air conditioners, reducing CO2 emissions associated with electricity generation.

A.3. Project participants:

Quality Tonnes (point of contact for this CDM activity)
Ghana Energy Foundation
Ghana Standards Board
The Government of Ghana will be represented by its DNA, which is still in the final staged of being established.
No Annex 1 Party is a project participant at this point.

NOTE: The Ghana Standards Board, which will be involved in the CER transaction, is a government agency but will require and receive authorization from the DNA of Ghana once it is established.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

Ghana

A.4.1.1. Host Party(ies):

The Government of Ghana

A.4.1.2. Region/State/Province etc.:

Entire Country of Ghana

A.4.1.3. City/Town/Community etc:

Entire Country of Ghana

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

The project will cover all room air conditioners used in the country of Ghana. The boundary for this project will be all consumers connected to the grid in Ghana, which covers most of the territory of the country.

A.4.2. Category(ies) of project activity:

Sectoral Scope 3: Energy Demand

A.4.3. Technology to be employed by the project activity:

More Efficient Room Air Conditioners

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

By implementing a room air conditioner standard, suppliers in Ghana will be forced to take the most inefficient units off the market and consumers will be forced to purchase more efficient models on average than they otherwise would. This will lead to direct electricity savings as consumers utilize less electricity to provide the desired level of cooling using the more efficient models.

In Ghana, the most expensive electricity based on operational costs comes from fossil-fuel based generators that emit CO2. The reduction in electricity demand from the energy savings from more efficient air conditioners will lead to a reduction in electricity production from the higher-cost production plants. The reduction in electricity production will directly reduce CO2 emissions. As the market for both air conditioners and electricity grows with Ghana's wealth and population, the energy savings tied directly to more efficient air conditioners will lead to fewer power plants being built. Since the most recent plants built in Ghana have been fossil-fuel based plants it is safe to assume the avoided plants would also be fossil-fuel based.

Ghana has been trying for a long time to try to implement appliance standards and is one of the most advanced African countries in its efforts. No other African country except South Africa has made comparable efforts to implement an appliance standard. In spite of the effort towards appliance standards in Ghana, program costs, financial investment, political will and other key barriers remain that CDM would be directly responsible for overcoming. For example, no mandatory standard can come into effect without the creation of a local appliance testing lab facility, with sensitive and expensive equipment available only in developed countries. The lab needs both start up and annual operational budgets, funding that the government currently lacks. The CDM revenue will be used to directly overcome this currently insurmountable barrier.

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

7 years- 3,043,281tonnes of CO2
21 years- 15 million tonnes of CO2

A.4.5. Public funding of the project activity:

No public funding from Annex one countries will be used to implement the air conditioner standard.

SECTION B. Application of a baseline methodology

B.1. Title and reference of the approved baseline methodology applied to the project activity:

This project uses a proposed new methodology. The proposed new methodology is entitled: "Energy Efficiency Through Mandatory Appliance Standards".

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

This proposed methodology is based on universal norms for standards practitioners around the world.[1] There is a portion of the methodology that has been used in other approved methodologies, specifically the combined margin approach to determine the baseline carbon emissions factor. Like renewable energy projects, energy efficiency adds additional kWh to the grid with no net increase in emissions. In fact, energy efficiency is commonly referred to as the most abundant renewable energy resource. To determine the carbon emissions impact from this project on the electricity currently generated and the future sources of electricity, it is logical survey the higher-cost plants which operate at the margin.

Ghana has growing demand that will continue to be unmet by current generation capacity. The low-cost hydro potential has been fully tapped in Ghana as seen by the exclusively thermal power plants built in recent years. Thus when calculating CO2 emission reductions, using an emissions factor derived from an average of the operating/build margins is the most appropriate way to measure the CO2 impact of the energy efficiency. By calculating the combined margin every year, any introduction of other fossil fuel

[1] See for reference the Collaborative Labelling and Appliance Standards Program (CLASP) Guidebook, an international NGO that brought together appliance standards experts to document best practices for implementing and evaluating standards at www.clasponline.org .

resources, such as the West African Gas Pipeline (which would replace oil with natural gas), will be reflected in the emissions reduction results.

B.2. Description of how the methodology is applied in the context of the project activity:

As required in the proposed methodology:

1. the project boundary is clearly defined as the country of Ghana and the carbon emissions factor will be determined by using the combined margin approach used in other EB-approved electricity sector projects.

2. The data to help define the baseline case has been gathered in a transparent and conservative manner including:

    a. the average efficiency (as measured in watts of cooling/watts of electricity) of the current population of room air conditioners in the country that are served by grid electricity;

    b. the historical efficiency improvement for room air conditioners (there are normal incremental increases in efficiency as newer, more efficient technology is slowly adopted by manufacturers in the absence of a standard that the baseline has to take into account)

    (Note these data are collected through statistically-significant sampling – in this project, the baseline data – the average efficiency of air conditioners and the average hours of use per day – has been determined through the surveying of 3,000 customers). This sampling size was deemed significantly significant using internationally-accepted statistical methods – evidence of this sampling plan will be presented to the DOE upon project validation.

3. Estimations have been made of the likely resulting energy savings, and CER revenue will allow a procedure to be put into place – including local trained experts – to track the key data required to calculate the emissions reductions.

4. The project developer has applied the additionality tool offered by the EB to this project and found that the project will only happen through CDM

Key Variable	**Data Source**
Total Population of New Room Air conditioners	Sales Data, Government Data, Confirmed though sampling of 3000 Households
Average Days of Use Annually	Scientific Survey of 3000 Households, national level data
Average Hours of Use per day	Scientific Survey of 3000 Households, national level data
Average Cooling Output per unit	Scientific Survey of 3000 Households, national level data
Average EER (Energy Efficiency Ratio)	Scientific Survey of 3000 Households, national level data
Carbon Emissions Factor Of Grid	National level data, Dept. of Energy, Ghana Energy Foundation, Volta River Authority

Average retirement age of units	National level data, Dept. of Energy, Ghana Energy Foundation, Volta River Authority
Key Assumptions	
Same # of AC units before and after standard (in other words, the price of higher-efficiency AC units is not substantially higher, so there will not be a reduction in AC sales. This has been shown to be the case in Ghana and data can be made available to the DOE to illustrate this.	
A large amount of sampling provides accurate data	

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

By implementing a room air conditioner standard, suppliers in Ghana will be forced to take the most inefficient units off the market, and consumers will have no choice other than purchasing more efficient models on average than they otherwise would. By dropping the most inefficient appliances from the market, the overall efficiency of new units sold will increase. This will lead to direct electricity savings as consumers utilize less electricity to provide the cooling.

Without the CDM project activity, Ghana would not plausibly adopt a mandatory standard for air conditioners. The Ghana Standards Board lacks the financial resources to build and operate an appliance testing laboratory which is critical to implementing a standard. Current legislation stipulates that without the lab (which is unfunded with no plans to the contrary) a mandatory standard cannot take affect.

The following is an overview of the review of the project using the draft additionality tool developed by the Executive Board. Once the tool is finalized, the following overview may change to fit any new format provided.

Step 0. Preliminary screening of projects started
The project takes place after 1 January 2000 and prior to 31 December 2005.

Step 1. Identification of alternatives to the project activity consistent with current laws and regulations

Sub-step 1a. Define alternatives to the project activity:

- *The project implemented without CDM*
- *Continuation of the current situation-Air Conditioner Efficiency Standards would not be implemented*

Sub-step 1b. Enforcement with applicable laws and regulations:
Neither of the alternatives contradicts local laws and regulations

Step 2: Investment Analysis: This step is not selected.

Step 3. Barrier Analysis
Sub-step 3a. Identify barriers that would prevent a wide spread implementation of the proposed

project activity:

Technology Barriers
Ghana lacks the technological capacity to test air conditioners to determine if they would meet a proposed standard. Most countries that implement appliance standards need testing laboratory facilities to ensure that the products sold on the local market from a diverse group of suppliers meet the proposed standard. Random testing is a vital enforcement tool to ensure that air conditioners in the market meet the standards, and thus Ghana needs to develop a testing lab and staff the lab with trained technicians.

In addition, implementing a standard requires constant analysis to determine the results (energy savings, cost savings, CO2 savings, etc). The monitoring requires extensive sampling of consumers to verify hours of use, etc., which is very labor-intensive. Not only will CDM provide the resources to create this monitoring network, but CDM also provides partners like the Ghana Energy Foundation that can create and maintain the monitoring system that provides the critical feedback loop.

Investment Barriers
Implementing an appliance standard requires capital to create and operate the testing laboratory required to implement the project. The lab will need to be built, maintained and staffed. Training will be required on how to use the sensitive and expensive equipment that must be imported. Without CDM this money is not available. The Ghanaian Government has been aware of the policy benefits of implementing a standard for almost 5 years. Data has been collected, draft legislative language written, and policy options weighed, but repeatedly, the Government has said that it lacks the financial resources to build and operate a testing lab and to do the required outreach and education to equipment importers, suppliers, and purchasers. In most areas, particularly the energy sector, the Government of Ghana currently has major budgetary problems. For example, it is required to come up with a significant amount of money to pay for part of the West African Natural Gas Pipeline and has been having trouble raising the funds. This, along with other budget priorities, will inhibit the mandatory standard from being implemented.

Education Barriers
Experience shows that policy makers, importers, distributors, and consumers all need to be educated in order to make an appliance standard successful. Without the full knowledge and cooperation of all these players, appliance standards have a tendency to fail. CDM will raise the profile of this effort and provide funding to outreach to these groups.

Sub-step 3 b. Show that the identified barriers would not prevent a wide spread implementation of at least one of the alternatives (excepted the proposed project activity already considered in step 3a):

It is clear that the barriers will not permit the project to go forward without CDM, but the second alternative-'Continuation of Current Situation' will clearly be unaffected by any of these barriers since all these barriers maintain the current situation.

Step 4. Common Practice Analysis
Sub-step 4a. Analyse other activities similar to the proposed project:
No similar activities are taking place in Ghana or other countries in Sub-Saharan West Africa.

Sub-step 4b. Discuss any similar options that are occurring:
N/A

Step 5. Impact of CDM Registration

The financial resources, visibility and technical resource brought to the table by CDM will be directly responsible for overcoming the aforementioned barriers. CDM revenues can be used to pay for the creating and staffing the testing lab. CDM revenues can also be used to set up an outreach and education system to help ensure the standards success. Project partners brought to the table through CDM like the Ghana Energy Foundation, can help set up and manage the critical policy feedback loop that will also serve as the CDM monitoring system.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

The baseline methodology asks the project developer to define a project boundary based on an existing political boundary. In this case the project boundary is the country of Ghana, a recognized autonomous political unit. The boundary also includes all of the thermal generating plants in the country, which will be used to determine the combined margin and thus the carbon intensity of the electricity saved.

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

The baseline study was completed Oct. 2004 by Kevin James of Quality Tonnes, and Dr. A.K. Ofuso-Ahenkorah of The Ghana Energy Foundation,.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

21 years

C.1.1. Starting date of the project activity:

2005

C.1.2. Expected operational lifetime of the project activity:

Under current circumstances, the base efficiency will not reach the proposed efficiency standard until well after 2030. The impact of the more efficient air conditioner standard will likely reverberate until at least 2040.

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

C.2.1.1. Starting date of the first crediting period:

2005

C.2.1.2. Length of the first crediting period:

7 years

C.2.2. Fixed crediting period:

NOT SELECTED

C.2.2.1. Starting date:

C.2.2.2. Length:

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

Energy Efficiency Through Mandatory Appliance Standards

D.2. Justification of the choice of the methodology and why it is applicable to the project activity:

This proposed methodology is based on universal norms for standards practitioners around the world. It is applicable in the context of the Ghana air conditioner standard because currently Ghana does not have a mandatory standards and CDM will be directly responsible for making the mandatory standard happen.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3-1	*Carbon Emissions Factor for the entire grid (EFy)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	*The carbon emissions factor will be determined using the combined margin approach outlined in ACM#0002.*
3-2	*Carbon Emissions from Operating Margin (EF_OMy)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-3	*Carbon Emissions Factor from build margin (EF_BMy)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-4	*Total GHG emissions from grid (TEMy)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*tCO2eq/year*	*C*	*Yearly*	*100%*	*electronic*	
3-5	*Total electricity to grid, excluding low-cost, zero*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*MWH/year*	*M*	*Yearly*	*100%*	*electronic*	

	emission sources (TGENy)							
3-6	*Amount of fossil fuel consumed in the grid (i. Fi,y)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*Physical unit*	*M*	*Yearly*	*100%*	*electronic*	
3-7	*GHG co-efficient of each fuel (COEFi)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*CO2/unit of fuel*	*M*	*Yearly*	*100%*	*electronic*	
3-8	*Electricity generation of the plant (jGENj,y)*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*MWH*	*M*	*Yearly*	*100%*	*electronic*	
3-9	*Plant identification for OM*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-10	*Plant identification for BM*	*Department of Energy, Ghana Energy Foundation, Volta River Authority*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-11								*Not required for this project*
3-12	*existing stocks of appliance including new units and retired units*	*official government and industry statistics and scientifically derived sampling data*	*# of units*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	
3-13	*appliance sales data by equipment model*	*official government and industry statistics and scientifically derived sampling data*	*# of units*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	*Used to help confirm 3-12*
3-14	*appliance sales data by*	*official government and industry*	*EER*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	*Used to help calculate 3-15*

	efficiency EER	*statistics and scientifically derived sampling data*						
3-15	*Average efficiency of new appliance population*	*official government and industry statistics and scientifically derived sampling data*	*Energy input (kW)*	*M and e*	*annual*	*Sample Size 3000*	*Electronicall y*	*Watts calculated by average Btu per hour of cooling capacity for the population of air conditioners divided by the average EER rating for the air conditioner (divided by 1000 for kw)*
3-15.a	*Average cooling capacity for population of air conditioners*	*official government and industry statistics and/or scientifically derived sampling data*	*Btu per hour of cooling*	*M and e*	*annual*	*Sample Size 3000*	*Electronicall y*	*Additional data required to calculate 3-15*
3-16	*testing lab results for equipment efficiency*	*official government and industry statistics and scientifically derived sampling data*	*Energy Efficiency Ratio (EER)*	*M*	*annual*	*100%*	*Electronicall y*	
3-17	*mean user days*	*official government and industry statistics and scientifically derived sampling data*	*# of days/year*	*M and e*	*annual*	*Sample Size 3000*	*Electronicall y*	
3-18	*mean user hours per day*	*official government and industry statistics and scientifically derived sampling data*	*# of hours per day*	*M and e*	*annual*	*Sample Size 3000*	*Electronicall y*	
3-19	*Average equipment retirement age*	*official government and industry statistics and/or scientifically derived sampling data*	*years*	*M and/or e*	*annual*	*Data delivered by the governmen t or*	*Electronicall y*	

						industry sources will be checked. The amount of direct monitoring is sampling is used will be determined by the sampling plan		
3-20	*Percentage of number of hours per year that new equipment is in operation*	*Sales Data and/or government/industry statistics and/or sampling*	*percent*	*M and/or e*	*annual*	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring is sampling is used will be determined by the sampling plan*	*Electronically*	

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

Project Emissions = TAE_x=

$$\left(\sum_{n=b+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

where $x\text{-}n \leq ara_n$ and x-1?b

or

Where $x\text{-}n > ara_n$

TAE_x=

$$\left(\sum_{n=x-ara_n+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

or

where x-1=b

TAE_x= $(TANE_x * K)$

where

$TANE_n = AEI_n * TNA_n * AU_x * EF_x$

Where
TAE= Total Actual Emissions
TANE=Total Annual New Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= air conditioner electric power input (kW) = average btu/h output divided by the average Energy Efficiency Ratio (EER))/1000)
AU= average use= average room new air conditioner operational hours per year= mean operating days/year*mean operating hours/operational day
TNA= total new room new air conditioner added to a population in given year
EF=Carbon emissions factor (tonnes CO2 / kWh)
? = percentage of average yearly user hours utilized by equipment bought in that year (%)

The actual emissions from year x are derived by calculating the impact in year x of all the air conditioners purchased after the air conditioner standard has gone into affect. The impact of air conditioners purchased in each year post standard is calculated by multiplying the average air conditioners electricity input (kw) and number of new units sold in the given year by the average use in year x (hrs/year) (avg. # of days/year* average number of hours per day) and the carbon emissions factor for year x. The average retirement age of the given year's equipment is calculated to ensure that emissions reductions are not counted for that year's equipment that has reached their average retirement age.

Emissions reductions from the new air conditioners purchased in the year x will be modified to only include actual hours use and the resulting savings. To determine actual hours of use, sales data will be gathered to determine what percentage of the average hours of use for that type of appliance that appliance was in service for. For example, if the average new air conditioner is purchased halfway through the cooling season, only half (K=50%) of the annual emissions reductions will be counted. In cases where sales data is not available a default value of 50% will be used.

The EF is calculated using the combined margin approach outlined in ACM#002 and methodology section D6. The EF will be calculated annual to account for any changes in electricity generation.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :								
ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3-1	*Carbon Emissions Factor for the entire grid (EFy)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*tCO2eq/MWH and tCO2eq/kWh*	*C*	*Yearly*	*100%*	*electronic*	*the carbon emissions factor will be determined using the combined margin approach outlined in ACM#0002.*
3-2	*Carbon Emissions from Operating Margin (EF_OMy)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authorityes*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-3	*Carbon Emissions Factor from build margin (EF_BMy)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-4	*Total GHG emissions from grid (TEMy)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*tCO2eq/year*	*C*	*Yearly*	*100%*	*electronic*	

3-5	*Total electricity to grid, excluding low-cost, zero emission sources (TGENy)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*MWH/year*	*M*	*Yearly*	*100%*	*electronic*	
3-6	*Amount of fossil fuel consumed in the grid (i. Fi,y)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*Physical unit*	*M*	*Yearly*	*100%*	*electronic*	
3-7	*GHG co-efficient of each fuel (COEFi)*	*IPCC*	*CO2/unit of fuel*	*M*	*Yearly*	*100%*	*electronic*	
3-8	*Electricity generation of the plant (jGENj,y)*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*MWH*	*M*	*Yearly*	*100%*	*electronic*	
3-9	*Plant identification for OM*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-10	*Plant identification for BM*	*Department of Energy, Ghana Energy Foundation, , Volta River Authority*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-11								*Not Applicable for this project*
3-12	*Total population of new air conditioners*	*official government and industry statistics and scientifically derived sampling data*	*# of units*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	

3-13	*appliance sales data by equipment model*	*official government and industry statistics and scientifically derived sampling data*	*# of units*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	*Used to help confirm 3-12*
3-14	*appliance sales data by EER efficiency*	*official government and industry statistics and scientifically derived sampling data*	*EER*	*M*	*annual*	*Sample Size 3000*	*Electronically*	*Used to help calculate 3-15*
3-15	*Average efficiency of new appliance population*	*official government and industry statistics and scientifically derived sampling data*	*kW*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	*Calculated by average Btu per hour of cooling capacity for the population of air conditioners divided by the average EER rating for the air conditioner (divided by 1000 for kw)*
3-15.a	*Average cooling capacity for population of air conditioners*	*official government and industry statistics and scientifically derived sampling data*	*Btu per hour of cooling*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	*Additional data required to derive 3-15*
3-16	*testing lab results for equipment efficiency*	*official government and industry statistics and scientifically derived sampling data*	*Energy Efficiency Ratio*	*M*	*annual*	*100%*	*Electronically*	
3-17	*mean user days*	*official government and industry statistics and scientifically derived sampling data*	*# of days/year*	*M and e*	*annual*		*Electronically*	

3-18	*mean user hours per day*	*official government and industry statistics and scientifically derived sampling data*	*# of hours per day*	*M and e*	*annual*	*Sample Size 3000*	*Electronically*	
3-19	Average equipment retirement age	official government and industry statistics and/or scientifically derived sampling data	*years*	*M and/or e*	annual	*Data delivered by the governmen t or industry sources will be checked. The amount of direct monitoring through sampling will be determined by the sampling plan*	*Electronically*	

3-20	Percentage of number of hours per year that new equipment is in operation	Sales Data and/or government/industry statistics and/or sampling	*percent*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling will be determined by the sampling plan*	*Electronically*	
3-21	*Historical annual efficiency improvement factor*	*official government and industry statistics and sampling data*	*Percentage of annual improvement of efficiency of appliance population*	*M*	*Once at beginning of project*	*Sample Size 3000*	*electronically*	*At least three years of data from the project country is needed for this figure. In cases where the data does not exist, the project developer can substitute conservatively interpreted global data cross-checked with local sample data.*

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> Since the population and market penetration of room air conditioners will likely change over course of the project, the baseline will measure the average electricity input of the new room air conditioners population in the baseline year, adjust it for normal efficiency improvements over time and then use the given

circumstances in the project year to determine what would have happened if the standard was not implemented. The project developer has calculated the expected improvement in new air conditioner population efficiency without any intervention using historical efficiency improvement data.

$TBE_x =$

$$\left(\sum_{n=b+1}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

where $x\text{-}b \leq ara_b$ and x-1?b

or

Where $x\text{-}b > ara_b$

$TBE_x =$

$$\left(\sum_{n=x-ara_b}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

or

where x-1=b

$TAE_x = (TANBE_x * K)$

where

$TANBE_n = (AEI_b / (1 + (HAEIF_b * n\text{-}b)) * TNA_n * AU_x * EF_x$

Where
TBE= Total baseline emissions
TANBE=Total Annual New Baseline Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= new air conditioner electric power input (kW) = (average btu/h output divided by the average Energy Efficiency Ratio (EER))/1000)
HAEIF=historical annual efficiency improvement factor = = average annual efficiency improvement of population of new room air conditioners (percentage)
AU= average use= average operational hours per year= mean operating days/year*mean operating hours/operational day
TNA= total new appliances in population in given year
? = percentage of average yearly user hours utilized by equipment bought in that year (%)
EF=Carbon emissions factor (tonnes CO2/kWh,)

The EF is calculated using the combined margin approach outlined in ACM#002 and methodology section D6. The EF will be calculated annual to account for any changes in electricity generation.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Option Not Selected

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.):

>>

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

There should be no leakage from this project. If it took more energy to produce or deliver a more efficient AC unit than a less-efficient model, there could be leakage. But the energy inputs into producing AC units are virtually the same regardless of the efficiency of the models.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> Through the baseline calculations, the project developer has determined what the emissions would have been in year x assuming no standard been put in place to increase the combined efficiency of the appliance's population. Now the project developer simply subtracts this figure from the actual emissions.

$TER_x = TBE_x - TAE_x$

Where

TER =Total Emissions Reductions
TAE= Total Actual Emissions
TBE= Total Baseline Emissions
x = year of calculated emissions reductions

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored		
Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
3-1	*Medium/low*	*Since the data will come from sources well out of the control of the project developer, no QA/QC procedures will be incorporated*
3-2	*low*	*Since the data will come from sources well out of the control of the project developer, no QA/QC procedures will be incorporated*
3-3	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-4	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-5	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-6	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-7	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-8	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-9	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-10	*Medium/low*	*Since the data will come from sources well out of the control of the project developer no QA/QC procedures will be incorporated*
3-11		*Not applicable for this project*

3-12	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-13	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-14	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. In the case of Ghana, all air conditioner units are imported – there is no domestic manufacturing. Therefore, official population figures can be checked with sales data, which is available, and cross-checked with import/customs data. Should Ghana ever produce air conditioners domestically, number of new units sold can be found out from the manufacturer. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-15	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-15a	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-16	*Medium/low*	*The data collected from lab will be used to confirm data collected from sampling and government/ industry sources.*
3-17	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-18	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-19	*Medium/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data.*
3-20	*High/low*	*The data collected from official or industry sources will checked for basic reliability, but no formal QA/QC procedures will be included. Any data obtained from sampling will fall within the sampling plans QA/QC procedures. These will follow basic norms for sampling data. Where data does not exist a default 50% value will be used.*
3-21	*Medium/low*	

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

>>The Ghana Energy Foundation has been trained to manage the day to day operations of making sure data collection is occurring accurately in the government, appliance manufacturers and importers, and the sampling data. Quality Tonnes will be part of the team that overseas reporting and results.

D.5 Name of person/entity determining the monitoring methodology:

>> Kevin James of Quality Tonnes and Dr. A.K. Ofuso-Ahenkorah of The Ghana Energy Foundation.

SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>>
For example:

Where x= 2005
b=2004

where x-1=b
2005- 1= 2004

$TAE_x = (TANE_x * K)$

where

$TANE_x = AEI_x * TNA_x * AU_x * EF_x$ = 4.89826 kw * 104535 total new air conditioners *2691 hr/year * .00088 tonnes CO2/kWh =606275.6

Where
TAE= Total Actual emissions
TANE=Total Annual New Emissions
x = 2005
b = 2004
ara = 14
AEI= new air conditioner electric power input (kW) = (13715/2.8)/1000 = 4.89826
AU= 299 days/year*9 hours/operational day= 2691 hrs/year
TNA= 104535
? = 50%
EF=.00088 tonnes CO2/kWh, see below

Hydropower and imported fossil fuel are the main energy sources used to generate electricity Ghana. VRA generates electricity from two hydro plants (at Akosombo and Kpong) and the thermal power plant at Aboadze (Takoradi 1 and 2). Ghana's first hyrdo plant, the Akosombo Generating Station in the Eastern Region, started producing 588 MW of power in 1965 from four generating units. In 1972, two additional generating units of 324 MW capacity were commissioned to bring Akosombo's total installed capacity to 912 MW. There have been further retrofits at Akosombo such that the current installed capacity is 1,020 MW. In 1982, a second hydro generation station, downstream of Akosombo, was commissioned on the Volta River at Kpong, also in the Eastern Region. This added another 160 MW capacity to that of Akosombo to bring the total installed hydropower generation capacity to 1,180 MW.

Significant thermal electricity generation started in 1999 when the Takoradi thermal power complex was commissioned. The total capacity of T1 and T2 is 550MW and is currently fired by fuel oil from Nigeria. These units are the highest cost of the total generation in Ghana and thus make up the operating margin. There are other smaller on-grid and off-grid diesel generating units scattered throughout the country as well. Since the newer thermal plants are the higher-cost and operating margin plants, the carbon emissions factor of the fuel oil will be multiplied by the additional output from the HRSG unit to calculate CO2 reductions.

Thus, the carbon emissions factor is straightforward because one fuel is currently used – light crude oil, which according to IPCC data has an emissions co-efficient 22.384 pounds of CO2/gallon or 940.109 per barrel. The total volume of Light Crude Oil used (actual fuel consumption) in T2 in 2003 was 1,466,463 bbl, corresponding to a total annual (actual) generation of 688 GWh. Fuel consumption per MWh of production is thus computed as 2.13 bbl/ MWh or 1.0012 TCO2/MWH for T2. As the table below indicates, VRA estimates that efficiency is expected to stay relatively stable.

For T1, which makes up the other half of the thermal load in Ghana, the plant used 2,319,524 bbl in 2003, to produce 1,323 GWH for an efficiency of about 1.75 barrels of oil per MWH. Thus, for every MWH generated, about .824 tonnes of CO2 is emitted for T1. In this case, the build margin and the operating margin are the same – since there are so few thermal plants.

T1 – .824 TCO2/MWH for 1,323 GWH
T2 – 1.0012 TCO2/MWH for 688 GWH

T1 accounts for about 2/3 of the thermal load in Ghana and T2 accounts for about 1/3. So accounting for the proportions of each facility, the emissions factor averages out .88 TCO2/MWH.

EF_OMy	Emissions factor	CEF from operating margin	.88 TCO2/MWH or.00088 tonnes CO2/kWh
EF_BMy	Emissions Factor	CEF from build margin	.88 TCO2/MWH
TEMy	Emissions	Total GHG emissions from grid	T1: .824 TCO2/MWH * 1,323,000 = 1,090,152 T2: 1.0012 TCO2/MWH * 688,000 = 688,825 TOTAL for 2003: 1,778,977 Tonnes of CO2
TGENy	Electricity	Total electricity to grid, excluding low-cost, zero emission sources	2011 GWH in 2003
7. i. Fi,y	fuel	Amount of fossil fuel consumed in the grid	T1 = 2,319,524 bbl T2 = 1,466,463 bbl Total 3,785,987 bbl
8. i. COEFi	CO2 co-efficient	GHG co-efficient of each fuel i	0.4264263 tonnes per bbl

Ghana does import electricity but it is a very small amount. This will be confirmed during project validation and if necessary adjusted according to the baseline methodology.

Data is estimated using statistical sampling done to determine the baseline and historical data plugged into the Lawrence Berkeley Laboratory Model Designed to anticipate the affects of appliance standards. The model contains non project data such as population trends and economic growth rends to estimate future sales. Actual data based on sales data and annual statistical sampling will replace the estimated data here.

E.2. Estimated leakage:

>>None

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>>

Year		Estimated Sales of New Room AC	Average Hours of Use per Day	Average days of Use per Year	Avg. Btu/hr of cooling	Avg. EER	Average Energy Input(KW)	MWh K=.5	Tonnes CO2 (EF=.000880 tonnes CO2/kWh) or .88 tonnes CO2/MWh
2011	new in 2011	168,983	9	299	13715	2.8	4.89826	1,113,701	980,057
	from previous 6 years							10,259,390	9,028,263
	2011 TOTAL							11,373,091	10,008,320
2010	new in 2010	156,807	9	299	13715	2.8	4.89826	1,033,454	909,439
	from previous 5 years							8,192,483	7,209,385
	2010 TOTAL							9,225,936	8,118,824
2009	new in 2009	145,206	9	299	13715	2.8	4.89826	956,996	842,156
	from previous 4 years							6,278,491	5,525,072
	2009 TOTAL							7,235,487	6,367,228
2008	new in 2008	134,186	9	299	13715	2.8	4.89826	884,367	778,243
	from previous 3 years							4,509,756	3,968,585
	2008 TOTAL							5,394,123	4,746,829
2007	new in 2007	123,741	9	299	13715	2.8	4.89826	815,529	717,665
	from previous 2 years							2,878,699	2,533,255
	2007 TOTAL							3,694,227	3,250,920
2006	new in 2006	113,859	9	299	13715	2.8	4.89826	750,400	660,352
	from							1,377,899	1,212,551

	previous year								
	2006 TOTAL							2,128,299	1,872,903
2005	new in 2005	104,535	9	299	13715	2.8	4.89826	688,949	606,275
	2005 TOTAL							688,949	606,275

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>>

Year	- -	**Estimated Sales of New Room AC**	**Average Hours of Use per Day**	**Average days of Use per Year**	**Avg. Btu/hr of cooling**	**Avg. EER**	**Average Electricity Input (kw) using calculated Historical Annual Efficiency Improvement Factor (.2%) –**	**MWh K=.5**	**Tonnes CO2 (EF=.000880 tonnes CO2/kWh) or .88 tonnes CO2/MWh**
2011	new in 2011	168,983	9	299	13715	2.596066	5.282993	1,201,176	1,057,035
	from previous 6 years							11,137,695	9,801,172
	2011 TOTAL							12,338,871	10,858,207
2010	new in 2010	156,807	9	299	13715	2.590885	5.293559	1,116,855	982,833
	from previous 5 years							8,903,984	7,835,506
	2010 TOTAL							10,020,840	8,818,339
2009	new in 2009	145,206	9	299	13715	2.585713	5.304146	1,036,296	911,940
	from previous 4 years							6,831,393	6,011,626
	2009 TOTAL							7,867,689	6,923,566
2008	new in 2008	134,186	9	299	13715	2.580552	5.314754	959,564	844,417
	from previous 3 years							4,912,264	4,322,793

	2008 TOTAL							5,871,829	5,167,209
2007	new in 2007	123,741	9	299	13715	2.575401	5.325384	886,642	780,245
	from previous 2 years							3,138,981	2,762,303
	2007 TOTAL							4,025,622	3,542,548
2006	new in 2006	113,859	9	299	13715	2.570261	5.336035	817,466	719,370
	from previous year							1,504,048	1,323,563
	2006 TOTAL							2,321,514	2,042,933
2005	new in 2005	104,535	9	299	13715	2.56513	5.346707	752,024	661,781
	2005 TOTAL							752,024	661,781
2005-2011	*TOTAL*							43,198,390	38,014,583

For example

X=2006
b= 2004
ara_b=14

2006-2004= 2<14 and 2?1
where $x-b \leq ara_b$ and x-b?1

TBE_x=

$$\left(S_{n=b+1}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

=TANBE2005 + (TANBE2006 *.5)=

1323562 + (1438740 *.5) = 1984023.79

where

$TANBE_n = (AEI_b / (1+ (HAEIF_b * n-b)) * TNA_n * AU_x * EF_x$

$TANBE_{2005}$ = (5.3574 / 1+ (.002 * 2005-2004)) *104535 *2691 * .00088 =1323562
$TANBE_{2006}$ = (5.3574 / 1+ (.002 * 2006-2004)) *113,859 *2691 * .00088 =1438740

Where
TBE= Total baseline emissions
TANBE=Total Annual New Baseline Emissions
x = 2006
b = 2004
n = b+1 (2005) through x-1=2005 = 2005
ara = 14
AEI_b= new air conditioner electric power input (kW) = (13715/2.56)/1000 = 5.3574
HAEIF=.002
AU= 299 days/year*9 hours/operational day= 2691 hrs/year
TNA_{2005}= 104535 , TNA_{2006}= 113859
? = 50%
EF=.00088 tonnes CO2/kWh,

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

Year	MWh	Tonnes CO2 (EF=.000880 tonnes CO2/kWh) or .88 tonnes CO2/MWh
2011	988775	849886
2010	813578.5	699515
2009	646865	556337
2008	488648.5	420380
2007	338897	291627
2006	197541.5	170030
2005	64476	55505.6

E.6. Table providing values obtained when applying formulae above:

Year	Tonnes CO2
2011	849886
2010	699515
2009	556337
2008	420380
2007	291627
2006	170030
2005	55505.6
TOTAL	3,043,281

SECTION F. Environmental impacts

F.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

Energy Efficiency improvements in room air conditioners will have no negative environmental impacts.

F.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

This project assumes that the same number of air conditioners would be replaced or new units bought with or without the standard. Because the production process for low efficiency or high efficiency appliances is virtually the same, there should be no additional environmental impacts from requiring a more efficient air conditioner. Thus, environmental impacts are not considered significant by the Host Party or the Project Participants.

SECTION G. Stakeholders' comments

G.1. Brief description how comments by local stakeholders have been invited and compiled:

In June 1999 the results of the first Appliance Ownership Survey conducted by the Energy Foundation in collaboration with the LBNL was released. This was presented to stakeholders at a workshop in Accra with recommendations for the introduction of appliance standards. The workshop was attended by appliance dealers, consumer associations, businesses and traders.

In 2001 the results of a detailed study on Room Air Conditioners was also released and discussed at similar workshops.

A stakeholder's workshop was held in January 2004 to highlight the economic impact of Standards. Speakers at the workshop included researchers from LBNL, the Ghana Standards Board and the Energy Foundation. Stakeholders who attended included the Ghana Union of Trade Associations, Appliance Importers and consumers associations.

In October 2004, a breakfast meeting was held with the major appliance importers to define strategies for the implementation of the appliance standards regime.

G.2. Summary of the comments received:

The consumer associations and consumers welcomed the idea of standards and labels as a means of identifying efficient appliances from inefficient ones. This is in the wake of increasing electricity tariffs and increased public education on energy efficiency. The dealers wanted more time and more public education before the standards were introduced. Some small businesses that import used appliances were concerned that the introduction of standards may adversely affect their business. The trade ministry and the EPA indicated that used air conditioner market was negligible and therefore did not make any difference.

G.3. Report on how due account was taken of any comments received:

The issue of more time has been addressed. A lot of education has been conducted on standards. The standards will be introduced in two phases. The first phase from January 2005-December 2005 is a period of voluntary compliance, until test laboratories are established. Mandatory compliance starts in January 2006. The 12 months will be used for intensive public education.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Quality Tonnes	Ghana Energy Foundation	Ghana Standards Board
Street/P.O.Box:	PO Box 3676	P.O.Box CT.1671	P.O. Box MB 245
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Represented by:	Kevin James	Alfred K. Ofosu-Ahenkorah	Nimo Ahinkorah
Title:	Managing Partner	Executive Director	Executive Director
Salutation:	Mr.	Dr.	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding from Annex 1 countries will be used to implement this project.

Annex 3

BASELINE INFORMATION

Since the population and market penetration of room air conditioners will likely change over course of the project, the baseline will measure the average electricity input of the new room air conditioners population in the baseline year, adjust it for normal efficiency improvements over time and then use the given circumstances in the project year to determine what would have happened if the standard was not implemented. The project developer has calculated the expected improvement in new air conditioner population efficiency without any intervention using historical efficiency improvement data.

Key Variables/Parameters	Data Source
Carbon Emissions Factor for the entire grid (EFy)	Calculated with Publicly available data using the combined margin approached outlined in ACM002.
Total population of new air conditioners	Based on sampling data and industry sales data
appliance sales data by equipment model	Based on sampling data and industry sales data
appliance sales data by EER efficiency	Based on sampling data and industry sales data
Average efficiency of new appliance population	Based on sampling data and industry sales data
Average cooling capacity for population of air conditioners	Based on sampling data and industry sales data
testing lab results for equipment efficiency	Not yet available but estimated using other testing lab data from other countries
mean user days	Based on sampling data
mean user hours per day	Based on sampling data
Average equipment retirement age	Based on sampling data
Percentage of number of hours per year that new equipment is in operation	Based on sampling data
Historical annual efficiency improvement factor	Based on sampling data, government data and industry sales data

TBE_x=

$$\left(\sum_{n=b+1}^{x-1} TANBE_n\right) + (TANBE_x * K)$$

where x-b $\leq ara_b$ and x-1?b

or

Where x-b > ara_b

TBE_x=

$$\left(\sum_{n=x-ara_b}^{x-1} TANBE_n\right) + (TANBE_x *K)$$

or

where x-1=b

$TAE_x = (TANBE_x * K)$

where

$TANBE_n = (AEI_b / (1+ (HAEIF_b * n-b)) * TNA_n * AU_x * EF_x$

Where
TBE= Total baseline emissions
TANBE=Total Annual New Baseline Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= new air conditioner electric power input (kW) = (average btu/h output divided by the average Energy Efficiency Ratio (EER))/1000)
HAEIF=historical annual efficiency improvement factor = = average annual efficiency improvement of population of new room air conditioners (percentage)
AU= average use= average operational hours per year= mean operating days/year*mean operating hours/operational day
TNA= total new appliances in population in given year
? = percentage of average yearly user hours utilized by equipment bought in that year (%)
EF=Carbon emissions factor (tonnes CO2/kWh,)

The EF is calculated using the combined margin approach outlined in ACM#002 and methodology section D6. The EF will be calculated annual to account for any changes in electricity generation.

Annex 4

MONITORING PLAN

Appliances such as air conditioners, refrigerators, lighting, motors, and many others are growing in popularity throughout the developing world. As more consumers are able to make purchases of these energy-consuming appliances, national power grids and fuel suppliers are asked to provide more service often increasing CO2 emissions.

The project developer will be responsible for the following steps

- Defining the project boundary- the specific appliance or subset of appliance that will be covered by mandatory standards
- Quantifying a baseline case scenario that determines what the energy consumption from the appliance would have been absent the mandatory efficiency standard (note: some efficiencies are generated in the market without a standard, so that has to be taken into account in the baseline)
- Quantification of the resulting reductions in energy use because of the mandatory energy efficiency appliance standard. This will be done through sample surveying of consumers each year to determine factors, such as hours of use, days of use, type of air conditioner model, etc. The project developer will develop a sampling plan for how to target a representative sample of consumers. This plan, which will be similar to the baseline survey, will be provided to the DOE upon project verification.
- Determining, using the approach outlined by the Executive Board's additionality tool, that the project would not happen without CDM.

More specifically, the project developer defines a specific political unit (country, state , etc.) that does not currently have a mandatory standard for the appliance in question or has a standard that can be improved.

The baseline is determined by calculating the amount of energy appliances would have consumed without the standard. Each year data on new appliance population and use is calculated this is then combined with the pre-standard average efficiency rating of the appliance adjusted by a business as usual annual efficiency improvement.

This is compared to the existing situation using the post-standard average efficiency rating of the appliance population. The resulting energy savings are then converted to CO2 savings using IPCC data for appliances that directly consume fuel or a combined margin approach that can most accurately depict the emission reduction impact of reducing the electricity consumption on the grid. Like with a renewable energy project, energy efficiency will allow existing generation plants to produce less electricity with the most expensive operational plants being the first to reduce output and fewer generation plants will have to be built in the future which would likely be of similar composition to the most recent plants built.

The project will use the Executive Board's proposed additionality tool to determine that the project would not have occurred without CDM. The tests including a review of potential alternatives, a financial or barriers additionality test, and a common practice test will make the case for why CDM is required to make this project happen.

Data to be collected or used in order to monitor emissions from the project activity, and how this data will be archived:								
ID number *(Please use numbers to ease cross-referencing to table B.7)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
3-1	*Carbon Emissions Factor for the entire grid* (EF_y)	*Public Data Sources*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	*In cases where this applies, the carbon emissions factor will be determined using the combined margin approach outlined in ACM#0002. In cases where electricity from the grid is not involved in the project 3-1 to 3-10 will not be applicable*
3-2	*Carbon Emissions from Operating Margin* (EF_OM_y)	*Public Data Sources*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-3	*CarbonEmissions Factor from build margin* (EF_BM_y)	*Public Data Sources*	*tCO2eq/MWH*	*C*	*Yearly*	*100%*	*electronic*	
3-4	*Total GHG emissions from grid* (TEM_y)	*Public Data Sources*	*tCO2eq/year*	*C*	*Yearly*	*100%*	*electronic*	
3-5	*Total electriicty to grid, excluding low-cost, zero*	*Public Data Sources*	*MWH/year*	*M*	*Yearly*	*100%*	*electronic*	

	emission sources (TGEN$_y$)							
3-6	*Amount of fossil fuel consumed in the grid* (i. $F_{i,y}$)	*Public Data Sources*	*Physical unit*	*M*	*Yearly*	*100%*	*electronic*	
3-7	*GHG co-efficient of each fuel* (COEF$_i$)	*IPCC*	*CO2/unit of fuel*	*M*	*Yearly*	*100%*	*electronic*	
3-8	*Electricity generation of the plant* (jGEN$_{j,y}$)	*Public Data Sources*	*MWH*	*M*	*Yearly*	*100%*	*electronic*	
3-9	*Plant identification for OM*	*Public Data Sources*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-10	*Plant identification for BM*	*Public Data Sources*	*Name*	*M*	*Yearly*	*100%*	*electronic*	
3-11	fuel emissions factor	IPCC	*CO2/unit of fuel (joules, Btus,liters, etc.)*	*m*	*annual*	*Data will not be directly monitored by project developer*	*Electronically*	*For use only in cases where appliance requires direct fuel input (natural gas water heaters)*
3-12	Total population of new appliance	official government and industry statistics and/or scientifically derived sampling data	*# of units*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through*	*Electronically*	

						sampling will be determined by the sampling plan		
3-13	New appliance sales data by equipment model	official government and industry statistics and/or scientifically derived sampling data	*# of units*	*M and/or e*	*annual*	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling will be determined by the sampling plan*	*Electronically*	
3-14	New appliance sales data by efficiency rating	official government and industry statistics and/or scientifically derived sampling data	*# of units*	*M and/or e*	*annual*	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling will be determined*	*Electronically*	*Helps determine 3-15*

						by the sampling plan		
3-15	Average energy input of new appliance population	official government and industry statistics and/or scientifically derived sampling data	*Energy input(kW, kj, etc.)*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring is sampling is used will be determined by the sampling plan*	*Electronically*	may require additional data to determine such as average size/capacity/output and efficiency rating per unit of output to determine
3-16	testing lab results for new equipment efficiency	official government and industry statistics and/or scientifically derived sampling data	*output per energy input*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked.*	*Electronically*	
3-17	mean user days	official government and industry statistics and/or scientifically derived sampling data	*# of days/year*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct*	*Electronically*	

						monitoring through sampling will be determined by the sampling plan		
3-18	mean user hours per day	official government and industry statistics and/or scientifically derived sampling data	*# of hours per day*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling will be determined by the sampling plan*	*Electronically*	
3-19	Average equipment retirement age	official government and industry statistics and/or scientifically derived sampling data	*years*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling*	*Electronically*	

						will be determined by the sampling plan		
3-20	Percentage of number of hours per year that new equipment is in operation	Sales Data and/or government/industry statistics and/or sampling	*percent*	*M and/or e*	annual	*Data delivered by the government or industry sources will be checked. The amount of direct monitoring through sampling will be determined by the sampling plan*	*Electronically*	

Total Project Emissions=

TAE_x=

$$\left(\sum_{n=b+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

where x-n ≤ ara_n and x-1?b

or

Where x-n > ara_n

TAE_x=

$$\left(\sum_{n=x-ara_n+1}^{x-1} TANE_n\right) + (TANE_x * K)$$

or

where x-1=b

$TAE_x = (TANE_x * K)$

where

$TANE_n = AEI_n * TNA_n * AU_x * EF_x$

Where
TER =Total Emissions Reductions
TAE= Total Actual Emissions
TANE=Total Annual New Emissions
x = year of calculated emissions reductions
b = baseline year
n = year
ara = average equipment retirement age
AEI= average appliance energy input (kW, joules, Btus, etc.)
AU= average use= average operational hours per year= mean operating days/year*mean operating hours/operational day
TNA= total new appliances in population in given year
? = percentage of average yearly user hours utilized by equipment bought in that year (%)
EF=Carbon emissions factor (CO2/fuel or electricity- units must match AEI's- kWh, joules, Btus, etc.)

The total emissions reductions per year x is the total calculated baseline emissions for year x minus the total of the actual emissions from year x. The actual emissions from year x are calculate by calculating the impact in year x of all the appliances purchased after the appliance standard has gone into affect. The impact of air conditioners purchased in each year post standard is calculated by multiplying the average

appliance energy input and number of units from the given year by the average use in year x (hrs/year) (avg. # of days/year* average number of hours per day) and the carbon emissions factor for year x. The average retirement age of the given year's equipment is calculated to ensure that emissions reductions are not counted for that year's equipment that has reached their average retirement age. Note: these factors, such as days/year and hours/day of use will be determined by an annual sample survey.

Emissions reductions from the new appliances purchased in the year x will be modified to only include actual hours use and the resulting savings. To determine actual hours of use, sales data will be gathered to determine what percentage of the average hours of use for that type of appliance that appliance was in service for. For example, if the average new refrigerator was purchased in June, only half (July-December or K=50%) of the annual emissions reductions will be counted. In cases where sales data is not available a default value of 50% will be used.

In cases where the energy input into the appliance is in the form of a direct fuel, the IPCC data will be used to determine the carbon content of fuel. In cases where electricity is used to operate the appliance, the following combined margin approach will be used to determine the EF. The EF will be calculated annually to account for any changes in electricity generation. The combined margin approach is taken directly from ACM#2 and is laid out in section D6 of the baseline methodology.

Instrumentation
The main instrument for data collection will be a sample survey.

Data Collection
The annual sample survey will be conducted by trained staff of the Ghana Energy Foundation and the Ghana Standards Board.

Data Analysis
The data will be analyzed by the Ghana Energy Foundation, Ghana Standards Board, and Quality Tonnes. All data will be kept electronically by the project participants.