SUSTAINABLE DEVELOPMENT STRATEGIES IN ENERGY EFFICIENCY IN GHANA

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Date: February 21, 2017

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1 CONTEXT

Describe the country's general energy context, including the sources of energy production and of greenhouse gas (GHG) emissions. Mention, if possible, the average efficiency of energy production and losses related to energy transmission and distribution.

Present any other relevant specificities related to the energy context in the country. Summarize the state of energy efficiency in the country and the country's energy efficiency strategy.

Overview of Ghana Energy Balance

Until 2011, woodfuel (charcoal and firewood) was the main primary energy source in Ghana. In 2011 however, biomass was overtaken by petroleum (oil and gas) as the dominant fuel following the commencement of commercial production of oil and gas in Ghana during the last quarter of 2010. Table 1 shows a 10-year trend in the supply of primary energy in Ghana from 2006-2015.

Table 1: Primary Energy Sources (KTOE)

Energy Source	Year									
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Oil	2,815	3,017	2,672	2,316	2,744	2,820	3,870	4,011	4,177	4,248
Natural Gas	0	0	0	5	394	769	390	292	621	1,182
Hydro	483	321	533	591	602	560	694	708	721	503
Wood	3,100	3,066	3,068	3,124	3,206	3,370	3,408	3,553	3,628	3,617
TOTAL	**6,398**	**6,404**	**6,273**	**6,036**	**6,946**	**7,519**	**8,362**	**8,564**	**9,147**	**9,550**

Source: Energy Commission, 2016

Table 1 shows that there has been approximately 50% increase in Ghana's primary energy supply over the past ten years rising from 6,398 ktoe in 2006 to 9.550 ktoe in 2015.

Table 2 on the other hand shows trends in final energy consumed in Ghana from 2006 to 2015. As evident from Table 2, petroleum is the main final energy consumed in Ghana, having overtaken biomass in 2009. Table 2 also shows that 7,157.50 ktoe of final energy was consumed in Ghana in 2015 with petroleum accounting for approximately 50% of final energy consumed, followed by biomass (~39%) and electricity (~11%)

Table 2 : Final Energy Consumed in Ghana (KTOE)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Electricity	621.30	539.20	597.70	615.40	674.20	772.10	851.90	908.40	919.80	829.00
Petroleum	1,872.60	2,126.60	2,071.30	2,597.70	2,491.10	2,826.60	3,172.10	3,303.00	3,271.70	3,543.80
Biomass	2,671.30	2,593.70	2,517.80	2,493.30	2,463.90	2,575.60	2,588.80	2,676.00	2,791.70	2,784.70
TOTAL	**5,165.20**	**5,259.50**	**5,186.80**	**5,706.40**	**5,629.20**	**6,174.30**	**6,612.80**	**6,887.40**	**6,983.20**	**7,157.50**

Source: Energy Commission, 2016

Electricity Supply

Electricity in Ghana is generated from two main sources – thermal and hydro. Total installed capacity as the end of 2015 stood at 3,566 MW as indicated in Figure 1. Approximately 56% (2,053 MW) of installed generation capacity is from thermal sources compared to approximately 43% (1,580 MW) from hydro. Total installed capacity of grid connected solar PV as the end of December 2015 was 22.5 MW, representing 0.6% of installed capacity. Total electricity generated and transmitted in 2015 was 11,492 Gigawatt Hours (GWh) compared to 13,071 GWh in 2014 and 12,927 GWh in 2013.

PLANT	FUEL TYPE	INSTALLED CAPACITY (MW)	Share (%)
Hydro			
Akosombo	Water	1,020	*27.9*
Bui	Water	400	*10.9*
Kpong	Water	160	*4.4*
Sub-Total		***1,580***	**43.2**
Thermal			
Takoradi Power Company (TAPCO)	LCO/Natural Gas	330	*9.0*
Takoradi International Company (TICO)	LCO/Natural Gas	330	*9.0*
Sunon Asogli Power (Ghana) Limited (SAPP) - IPP	Natural Gas	200	*5.5*
Cenit Energy Ltd (CEL) - IPP	LCO	126	*3.4*
Tema Thermal 1 Power Plant (TT1PP)	LCO/Natural Gas	110	*3.0*
Tema Thermal 2 Power Plant (TT2PP)	DFO/Natural Gas	50	*1.4*
Takoradi T3	LCO/Natural Gas	132	*3.6*
Mines Reserve Plant (MRP)	DFO/Natural Gas	80	*2.2*
Kpone Thermal Power Plant (KTPP)	Natural Gas	220	*6.0*
Karpowership	HFO	225	*6.2*
Ameri Plant	Natural Gas	250	*6.8*
Sub-Total		***2,053***	**56.2**
Renewables			
VRA Solar	Solar	2.5	*0.1*
BXC Company	Solar	20	*0.5*
Sub-Total		***22.5***	**0.6**
Total		**3,656**	**100**

Source: Energy Commission, 2016

Figure 1: Total Installed Generation Capacity in Ghana as December 2015

As indicated in Figure 1, Ghana's thermal plants are fired mainly by Light Crude Oil (LCO) and natural gas. In 2015 a total of 248.7 KTOE of LCO and 46,911,854 mmBtu (46,912 mmscf) of natural gas was used to generate 5,644 GWh of electricity from the thermal plants compared to 632.1 KTOE of LCO and 23,633.724 mmBTU (23,631 mmscf) of natural gas used to generate 4,572 GWh of electricity in 2014. In 2016 112.3 KTOE of LCO, 54,900 mmscf of natural gas, 1.51 million barrels of Diesel Fuel Oil (DFO) and 2.8 million barrels of Heavy Fuel Oil (HFO) was estimated to be required for the generation of a projected total of 11,535 GWh of electricity from thermal sources (Energy Commission, 2016).

Although Ghana has been producing crude oil since late 2010, all the LCO used in power generation are imported whereas the natural gas is sourced from Nigeria via the West African Pipeline (WAGP) and locally from the Atuabo Gas Processing Plant in Ghana. Until December 2014, virtually all the lean gas used in generating electricity was imported from Nigeria. However, significant proportion from gas supplies is being sourced locally following the completion and commissioning of the gas process plant in Ghana in December 2014 with indigenous contributing 56% of total gas used in 2015.

The electricity supplied from hydroelectric sources is generated locally from three hydroelectric dams as shown in Figure 1.

Access to Electricity

An estimated 70.6% of Ghanaians had access to electricity in 2014 with approximately 89% (88.6%) of urban households having access to electricity compared to 48.3% of their rural counterparts (Ghana Statistical Services, 2014).

Electricity System Losses

Electricity transmission losses have averaged 3.99% over last 10 years peaking at 4.8% in 2013 as shown in Table 3.

Table 3: Transmission Losses in Ghana from 2006 to 2015

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Transmission Losses (MW)	318	256	303	343	380	531	522	569.7	565	402
Losses as % of Net Generation	3.5	3.5	3.5	3.8	3.7	4.7	4.3	4.8	4.3	3.8

Source: Energy Commission, 2016

There are two main publicly owned distribution utilities in Ghana – the Electricity Company of Ghana (ECG), responsible for power distribution in Southern Ghana and the Northern Electricity Distribution Company (NEDCo) in charge of Northern Ghana. Distribution losses for ECG has been averaging 24.8% between 2006 and 2015 as shown in Table 4.

Table 4: ECG Power Purchase, Sale and Losses

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Purchases (GWh)	5,253	5,146	5,799	6,052	6,771	7,259	7,944	8,479	8,370	7,544
Sales (GWh)	3,978	3,909	4,316	4,482	4,972	5,285	6,079	6,496	6,262	5,831
Losses (GWh)	1,275	1,237	1,483	1,570	1,799	1,974	1,865	1,983	2,108	1,713
% Losses	24.3	24.0	25.6	25.9	26.6	27.2	23.5	23.4	25.2	22.7

Source: Energy Commission, 2016

Similarly, NEDCo's losses have averaged 24.1% over the past 10 years as shown in Table 5.

Table 5 : NEDCo Power Purchases, Sales and Losses

Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Purchases (GWh)	507	494	529	566	635	719	822	937	998	992
Sales (GWh)	356	366	391	413	511	580	657	737	758	719
Losses (GWh)	151	128	138	153	124	139	165	200	240	273
% Losses	29.8	25.9	26.1	27.0	19.5	19.3	20.1	21.3	24.0	27.5

Source: Energy Commission, 2016.

At the end-use level, approximately 30% of electricity delivered to consumers is estimated to be wasted as a result of inefficient electrical appliances, equipment and also wasteful power consumption behaviour (Ministry of Energy, 2010).

GHG Emissions

Ghana emitted a total of 33.66 million tonnes of carbon dioxide-equivalent ($MtCO_2e$) in 2012 compared to 14.22 $MtCO_2e$ and 16.32 $MtCO_2e$ recorded in 1990 and 2000 respectively, representing 136.7% and 106.2% increases above 1990 and 2000 GHG emissions levels respectively. Net national GHG emissions (excluding emissions and removal from the Agriculture, Forestry and Other Land Use (AFOLU) sector) was 18.49 MtCO2e in 2012 (MESTI[1], 2015). The AFOLU sector was the largest contributor of GHG emissions in 2012, accounting for 45% of total emissions. This was followed by the energy sector (responsible for 40.1% of emissions), Waste (13.4%) and Industrial Processes and Product Use (IPPU) (1.4%) as shown in Figure 1.

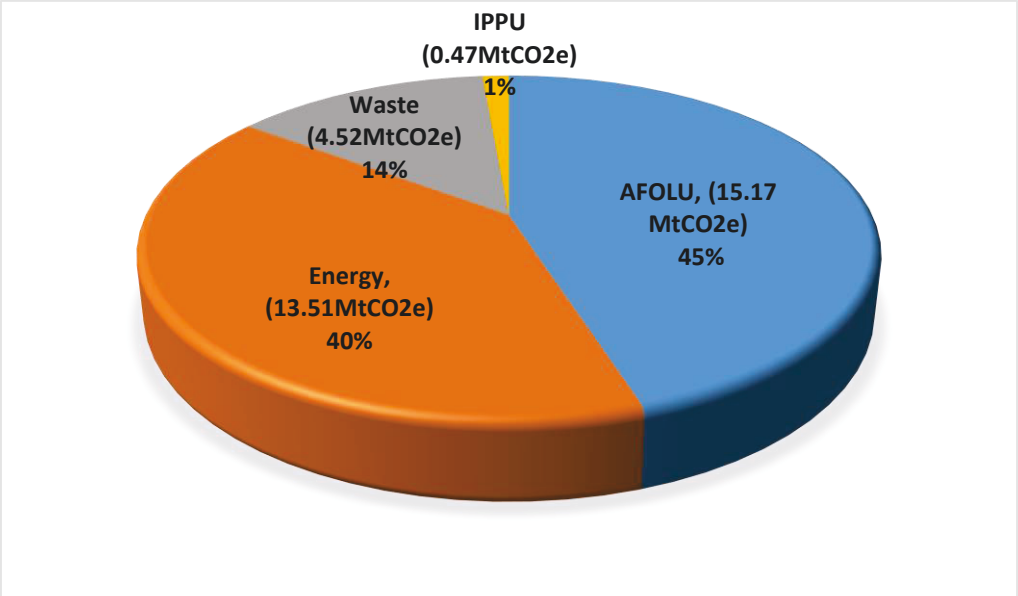

Figure 2: Total GHG Emissions in Ghana in 2012

Without taking into account emissions from the AFOLU sector in the national totals, the energy sector was the leading emitter of GHGs in 2012, contributing 73% of total emissions. This was followed by Waste and IPPU sectors with each of them accounting for 24% and 3% respectively of total emissions that were generated in Ghana in 2012. In terms of emissions by sources, carbon dioxide (CO_2) was the dominant GHG contributing 44% (14.81Mt) of the total net emissions in 2012. This was followed by nitrous oxide (N_2O), which accounted for 30.8% (10.38 $MtCO_2e$) and methane (CH_4) responsible for 24.8% (8.36 MtCO2e) of total net emissions in 2012. The remaining 0.35% (or 0.11 $MtCO_2e$) of total net emissions came from the Perflourocarbons (PFCs) (MESTI, 2015).

[1] MESTI – Ministry of Environment, Science, Technology and Innovation.

Out of the total net CO_2 emission of 14.81 Mt emitted in 2012, the energy sector accounted for 85% (12.59 Mt). This was followed by AFOLU (12.6% or 1.86 Mt) and IPPU (2.4% or 0.35 Mt) as shown in Table 6.

Table 6 : Net National GHG Emissions by Sectors in 2012

Sectors and sub-sectors	Emissions				Share of Total Emissions		
	Mt	$MtCo_2e$					
	CO_2	CH_4	N_2O	PFC	Total	%	%
1. All Energy (combustion & fugitive)	12.59	0.64	0.27	0.00	13.51	73	40.1
Stationery energy combustion	6.29	0.60	0.15	0.0	7.0	38	
Transport	6.30	0.04	0.12	0.0	6.5	35	
Fugitive emission	0.00	0.00	6.4E-06	0.0	0.002	0	
2. Industrial Process & Product Use	0.35	0.00	0	0.11	0.47	3	1.4
3. Waste	0.00	4.02	0.49	0.0	4.5	24	13.4
4. AFOLU	1.86	3.70	9.62	0.00	15.17	100	45.1
Livestock	0.00	2.13	0.9	0.0	3.0	20	
Land	1.84	0.00	0.0	0.0	1.8	12	
Aggregated and Non-CO_2 emissions	0.02	1.57	8.7	0.0	10.3	68	
Total net emissions (including AFOLU)	**14.81**	**8.36**	**10.38**	**0.11**	**33.66**		**100**
Total emissions (excluding AFOLU)	**12.95**	**4.66**	**0.76**	**0.11**	**18.49**	**100**	

Source : MESTI, 2015

Carbon dioxide (CO_2) is the most important GHG source in the energy sector, contributing 93% of emissions generated in the sector in 2012 with transport and electricity generation being the main sources. In the same year, emissions from stationery energy combustions (mainly power plants and industrial source points) constituted 52.2% of total GHGs emitted from the sector while those from mobile combustion (transport) accounted for 47.8% of emissions with fugitive emissions contributing the remaining 0.01%. (MESTI, 2015).

There was a 158.10% increase in GHG emissions from stationery energy combustion from 2.73 $MtCO_2e$ in 2000 to 7.07 $MtCO_2e$ in 2012. This was caused mainly by the increase in the share of thermal electricity in the total electricity generation from 8.5% in 2000 to 32.9% in 2012, which resulted in a corresponding increase in GHG emissions from 0.48 MtCO2 to 3.18 MtCO2e over the same period. In 2012, emissions from thermal power plants ranked the second most important source of GHG emissions in the energy sector (MESTI, 2015).

Status of Energy Efficiency in Ghana

As indicated above, the production, transmission and utilisation of energy in Ghana is characterised by high levels of inefficiencies and wastage with transmission and distribution losses averaging 4% and 25% respectively over the past decade while wastage at the demand-side is estimated around 30%.

Reducing such high losses and wastage is therefore the key driving force behind the energy efficiency policy and strategies for Ghana. Ghana's energy efficiency and conservation policy is thus designed to ensure efficient production and transportation as well as end-use efficiency and conservation of energy. In order to reduce wastage at the end-use end of the electricity value chain, the government in its 2010 Energy Policy indicated, among other things, its intention to implement a comprehensive Demand-Side Management (DSM) Programme. The key objectives of the proposed DSM Programme were as follows:

- Encourage efficiency in energy use in all sectors of the national economy;
- Improve the productivity and competitiveness of Ghanaian industries through the use of more efficient technologies;
- Improve system reliability by reducing demand; and
- Reduce and manage power system demand through load shifting

As stated in the relevant portion of the 2010 Energy Policy, the strategic framework of the energy efficiency policy focuses on removing the obstacles that have constrained the promotion and implementation of energy efficiency and conservation measures. This is expected to be achieved through the application of fiscal and financial incentives, awareness creation and institutional intermediation.

Specifically strategies that were expected to be implemented/introduce to deal with the bottlenecks are as follows:

- Establish appropriate pricing regime for energy services that would encourage (provide incentive) domestic and industrial consumers to voluntarily manage their energy consumption;
- Develop and implement programmes and measures to help consumers optimize their energy use; and
- Support a sustained and comprehensive public education and awareness building campaign on the methods and benefits of energy conservation.
- Discontinue, through legislation, the local production, importation and use of inefficient electricity consuming equipment and appliances (Ministry of Energy, 2010).

2 POLITICAL FRAMEWORK

2.1 National Energy Efficiency Targets

Table 7: National Targets

Category	Target	Sector	Funds & Investments	Description
GHG reduction target	Unconditionally[2] lower emissions by 15% relative to business-as-usual (BAU) scenario emission of 73.95 $MtCO_2e$ by 2030 through the implementation of 2 programs of actions. An additional 30% emission reduction is attainable on **condition** that external support is made available to Ghana to cover the full cost of implementing 19 mitigation programs of action With this external support, a total emission reduction of 45% below the BAU emission levels can be achieved by 2030	Energy, Transport, AFOLU, Waste and Industry.	An amount of 9.81 billion being total investment cost would be required for implementing the 19 mitigation actions over the 10-year period (2020-2030). Out of the USD 9.81 billion, Ghana is expected to mobilize USD 2.02 billion (21% of the total investment cost) to finance the two unconditional INDCs program of action. An additional USD 7.79 billion will be needed to finance the remaining 17 mitigation program of actions in order to achieve more ambitious emission reductions in the 10 year period.	In all, 19 mitigation programs of actions in five priority economic sectors (energy, transport, waste, agriculture and forest and industry) are being proposed for implementation in the 10-year period. The program of actions are to implemented to achieve the broad objectives set out in following 9 policy action areas: 1. Scale up renewable energy penetration by 10% by 2030 2. Promote clean rural households lighting 3. Expand the adoption of market-based cleaner cooking solutions 4. Double energy efficiency improvement to 20% in power plants 5. Scale up sustainable mass transportation 6. Promote Sustainable utilization of forest resources through REDD+ 7. Adopt alternative urban solid waste management 8. Double energy efficiency improvement to 20% in industrial facilities 9. Green Cooling Africa Initiative Detailed list of the 19 Mitigation Actions are attached in the Annexure.

[2] Under unconditional emission reduction goal, emission reduction is expected to be achieved through the implementation of mitigation actions with support mobilized unilaterally by the government of Ghana without any international support.

Category	Target	Sector	Funds & Investments	Description
EE improvement target	Reduce the average electricity intensity in the Residential and Commercial sectors from an average of 2-2.4:1 to 1.5:1 by 2015 and maintaining the ratio up to 2020.[3]	Residential and Commercial	Estimated to around US$56 million in 2006	Activities proposed under the SNEP include EE standards and labels, monitoring and targeting (M&T), energy management schemes, electrical load management, electric motor improvement projects, energy management in high-rise buildings, industrial cogeneration and fuel substitution, in addition to reactivating the energy centres. SNEP further proposes increasing the number of energy fund levies or setting up a special-purpose
Sectorial EE improvement target	Double energy efficiency improvement to 20% in power plants Double energy efficiency improvement to 20% in industrial facilities	Energy Industry	US$ 1 billion US$ 8.4 million	Scale up 120 million standard cubic feet (MSCF) natural gas replacement of light crude oil for electricity generation in thermal plants. Scaling up of installation of power factor correction devices in 1,000 commercial and industrial facilities (capacitor banks).

[3] Energy Commission, 2006

2.2 Legislative and Regulatory Framework

Table 8: Legislative and Regulatory Framework

Laws & Regulations	Status	Year	Name of Law or Regulation	Description
Law of EE	Non-existent			Although there is no consolidated law on energy efficiency and conservation there is some statutory backing for the promotion of the energy efficiency/conservation in several Legislative Instruments. An Energy Efficiency and Conservation Act Energy – that was expected to spell out mandatory energy management practices, building codes, requirements on energy efficiency levels of energy consuming equipment, energy audit regimes for formal industries and commercial entities such as hotels – was proposed for consideration in the Strategic National Energy Plan (SNEP), 2006-2020. However, the Act is yet to be crafted and put before Parliament for consideration.
Building Code	In progress	2016 till date	Energy Efficiency Building Codes	Intended to be used to regulate the design and construction of buildings to ensure the effective use and conservation of energy over the useful life of each building.
Regulation to phase-out of old technologies	Adopted	2008	Energy Efficiency (Prohibition of Manufacture, sale or importation of Incandescent Lamps, Used refrigerator, freezers, refrigerator-freezer and AC) Regulations, 2008 (LI1932)	Legislative Instrument 1932 prohibits the importation and sale of incandescent lamps, used ACs and used refrigerators in the country. According to the Energy Commission, LI 1932 has succeeded in eliminating the energy inefficient incandescent lamps from the Ghanaian market and is expected to help eliminate 'dumping' of used ACs and refrigerators in Ghana.

Laws & Regulations	Status	Year	Name of Law or Regulation	Description
Standards and Labeling	Adopted	2005 2008 and 2009	1. Energy Efficiency Standards and Labelling (Non-ducted ACs and Self-Ballasted Fluorescent Lamps) Regulations, 2005 (LI1815) 2. Energy Efficiency Standards and Labelling (Household Refrigerating Appliances) Regulations, 2009 (LI1958) 3. Energy Efficiency (Prohibition of Manufacture, sale or importation of Incandescent Lamps, Used refrigerator, freezers, refrigerator-freezer and AC) Regulations, 2008 (LI1932)	LIs 1815 and 1958 prohibit the importation of AC, refrigerators and CFLs that are not properly labeled and do not meet specified minimum energy efficiency and performance standards. LI 1815 for example enjoins manufacturers and/or importers of non-ducted ACs and self-ballasted fluorescent lamps in Regulation 2 (1)(a &b) to ensure that ACs and lamps that are brought into the country are compliant with the standard specifications stipulated in Ghana Standard (GS) 362:2001 and GS 324:2003 respectively. Regulation 4 (1) of LI 1815 prohibits the sale, distribution, importation or disposal of non-ducted ACs without an energy guide label that indicate, among other things, the minimum performance standard of the product. The acceptable minimum energy efficiency standard for ACs in Ghana is an Energy Efficiency Ratio (EER) of 2.8 watts of cooling per watt of electricity input. The label, which must be affixed to the product, must provide important information on the model, manufacturer, and energy efficiency star rating (a one-star to five –star energy efficiency rating in which the ascending number of stars represents a higher energy efficiency ratio), estimated annual energy consumption, cooling output and type of refrigerant. The Energy Guide label for CFLs must also contain information on wattage, average rated life in hours, and an estimate of annual energy consumption, as well as the energy efficiency star rating. A service life of 6,000 hours and efficacy of 33 lumens are the minimum performance standards for CFLs.
Industrial Regulation	Adopted	2005	Electricity Supply and Distribution (Technical and Operational) Rules (LI 1816)	Section 10 of LI 1816 makes it mandatory for an electricity supplier to an industrial customer to advice the customer on the appropriate step to be taken to ensure that the customer's load power factor is within a range specified in the LI. The customer shall within an agreed time install shunt compensators on its electrical system to improve the power factor and minimise line losses. In the event that the customer fails to act, the supplier shall impose a power factor surcharge (PFS), which determined by the Public Utilities Regulatory Commission (PURC). The PFS was originally introduced in 1995 and designed to levy a penalty equivalent to 1% increase in maximum demand charge for each 1% decrease in power factor below the minimum performance standard of 0.95 (later reduced to 90%).

2.3 Financial Incentives

Table 9: Summary of Energy Efficiency Financial Incentives

Financial Incentive	Status	Year	Sector	Description
EE fund	Existing	1995	Industrial and Commercial	Revenue accruing from the Power Factor Surcharge (PFS) is expected to be paid into a special account – Electricity Demand Management Fund (EDMF) – to be used to expedite the bulk procurement and importation of the equipment and instrumentation for power factor correction, time-of-day metering and pre-payment meters. The EDMF is reported to have earned around in 6 million cedis (US$1.37million) in 2014. Also, the Energy Fund established in 1997 under the Energy Commission Act (Act 541) was partly intended to be used to promote energy efficiency. Over the years however, money realised through the Energy Fund have ended up being used mainly to run the Energy Commission and partly to fund some renewable energy projects.
Tax Benefits	Non-existent			CFLs and LEDs used to be VAT exempt until January 2016 when the exemption was waived and VAT reintroduced. Currently VAT of 15% is chargeable/payable on CFLs and LEDs
EE Subsidies	Non-existent			
Energy Subsidies	Non-existent			However, the electricity tariff as structure promotes energy conservation and efficiency since consumers pay more the higher their monthly consumption.
Relief of Custom Duties	Non-existent			CFLs and LEDs used to be zero-rated (import duty exempt) until January 2016 when import duty of 20% and 10% for CFLs and LEDs respectively was reintroduced. It could be argued however that LEDs enjoy a 10% custom relief when compared to CFLs
Tax on inefficient equipment	Existing	1995	Industrial	Power Factor Surcharge (PFS) was designed to levy a penalty which will be equivalent to 1% increase in maximum demand charge for each 1% decrease in power factor below the minimum performance standard of 0.95% (the standard was later reduced to 90%).

3 OVERVIEW OF ENERGY EFFICIENCY INITIATIVES IMPLEMENTED

3.1 Energy Efficiency Programs

Table 10: Summary of Energy Efficiency Programs

Program Name	Institution	Sector	Description	Measures/Activities	Year	Budget
Ghana Electrical Appliance Labelling and Standards Programme (GEALSP)	Energy Commission and Energy Foundation, supported by Ghana Standard Authority, Customs Excise and Preventive Services (GRA)	Residential, commercial and institutional	To develop energy efficiency performance standards and labels for selected electrical appliances in Ghana. The Programme was designed to ensure that only appliances that meet minimum energy efficiency standards enter the Ghanaian market. The introduction of the MEPS on room ACs was projected to save Ghana 950 GWh of electricity per year by 2020, freeing up to approximately 250 MW for other purposes (See Sanchu, et al, 1999)	› Develop minimum efficiency performance standards (MEPS) and appliance labels for Room Air Conditioners (RAC), Lighting and Refrigerators in Ghana	2000-2009	US$3-5 million
The CFL Exchange Programme	Energy Commission	Residential	Procurement and free distribution of 6 million CFLs to households as direct replacement of incandescent lamps as a load reduction measure to mitigate the impacts of power shortage. The replacement of 6 million CFLs resulted in the peak savings of 124 MW or 172.8 GWh/annum, thereby delaying thermal energy expansion investment of US$105 million (Energy Commission, 2009)	› Procure and distribution of CFLs to districts › Massive Public Education › Replacement of incandescent bulbs with CFLs › Training of Replacement “Gangs” › Destruction of Incandescent Lamps	2007	US$15.5 million
Promoting of Appliance Energy Efficiency and Transformation of the Refrigerating Appliance Market in Ghana	Energy Commission	Residential	The primary objective of the project was to improve the energy efficiency of appliances marketed and used in Ghana through the introduction of a combination of regulatory tools such as MEPS and Information Labels (S&L), and innovative economic tools. The project will strengthen the regulatory and institutional framework, develop monitoring and	› Strengthening of regulatory and institutional framework › Design of certification, labeling and enforcement systems › Training & public outreach › Establishment of refrigerating appliance test facility	July, 2011 – June, 2014	US$6.12 million

Program Name	Institution	Sector	Description	Measures/Activities	Year	Budget
			enforcement mechanisms, and provide training to appliance professionals. The project was used to explore and test efficient market-based economic incentives complemented by repeated public outreach campaigns. Domestic refrigeration appliances will be the first end-use devices to be tackled, with a specific focus to address ozone depleting substances contained in the current stock of equipment. The Refrigerator Energy Efficiency Programme is reported to have resulted in the saving of 400 GWh/annum over 3 years.	› Used appliance collection and disposal facilities › Efficiency program evaluation and monitoring capacity development › Conduct of refrigeration appliance rebate and exchange program › Financial design of follow-up national market transformation programs		
Performance Standards and Labelling for LED Lighting in Ghana	Ghana Standards Authority/ Energy Commission	Residential Institutional	To develop, introduce and enforce energy performance standards and labelling to ensure high quality LED lamps in Ghana	› Compile all relevant data on existing technical performance standards and labelling schemes › Review LED standards developed in China and by Lighting Africa with support from REEEP › Develop appropriate technical performance standards and labels for LEDs for Ghana › Review the draft performance standards and labelling with stakeholders and incorporate their input into the proposal › Transform technical performance standards into draft regulations › Solicit stakeholder input on draft regulations, make appropriate revisions, and pass regulations into legislation	2012-2013	€98,500

Program Name	Institution	Sector	Description	Measures/Activities	Year	Budget
Energy Efficiency and Demand Side Management Project	Millennium Development Authority (MiDA) /Energy Commission	Commercial Industrial	It is the 5th Component of the Millennium Challenge Compact signed between the United States of American and Ghana. The project will offset demand for electricity, which has exceeded supply in Ghana, and help consumers save money by improving energy efficiency, reducing peak demand, and increasing both local technical capacity for efficiency retrofits and awareness, and public understanding of energy efficiency in the country.	› Develop and enforce MEPS and labels for priority appliances and equipment; › Build energy auditing capacity in Ghana; › Finance demonstration retrofits of select facilities; › Conduct a public-awareness campaign to promote energy efficiency; › Conduct a public-awareness campaign to promote energy efficiency; › Convert streetlights in priority areas to highly efficient LED lighting	2014-2019	US$25.4 million
Accra Bus Rapid Transit (BRT) Project	Ministry of Roads and Transport	Transport	It is sectoral measure to improve public transport systems through improvement in efficiency and affordability, reduction in congestion as well as reduction in GHGs emissions in the Central Business District (CBD)-Kasoa transit corridor in Accra. The BRT system provides an opportunity for mitigating GHG emissions through the use of new energy-efficient buses that are climate friendly compared to obsolete buses, light vehicles and taxis that are currently used on the corridor.	› Construction of BRT infrastructure › Traffic engineering management and safety › Installation of Intelligent Transport System (ITS) › Procurement of buses › Institutional development › Marketing and branding › Monitoring and evaluation	Launched in 2016	US$95 million
Ghana Energy Access Development Project (GEDAP)	Ministry of Energy	Energy	The overall objective of the GEDAP was to improve the operational efficiency of the electricity distribution system and increase the population's access to electricity, and to help transition Ghana to a low-carbon economy through the reduction of greenhouse gas emissions. The programme was originally expected to end	› The project has three main components: (a) sector and institutional development, (b) distribution improvement, (c) electricity access and RE,	2007-2015	US$210.55 million

Program Name	Institution	Sector	Description	Measures/Activities	Year	Budget
			by 2012 but has subsequently be extended on two occasions.	› The Distribution Improvement component entailed the following: - construction of eight new 33/11 kV substations along with the feeders; - construction and strengthening of bulk supply points; - upgrade of existing substations in several targeted distribution areas;		

3.2 Summary of International Support in Energy Efficiency

Table 11: Summary of International Energy Efficiency Projects in the Country

Institution	Program	Objective	Activities	Budget	Status
Millennium Challenge Corporation (MCC)	Energy Efficiency and Demand Side Management Project	To offset demand for electricity, which has exceeded supply in Ghana, and help consumers save money by improving energy efficiency, reducing peak demand, and increasing both local technical capacity for efficiency retrofits and awareness, and public understanding of energy efficiency in the country	› Develop and enforce energy-efficient standards and labels for priority appliances and equipment; › Build energy auditing capacity in Ghana; › Finance demonstration retrofits of select facilities; › Conduct a public-awareness campaign to promote energy efficiency; and › Conduct a public-awareness campaign to promote energy efficiency; and › Convert streetlights in priority areas to highly efficient LED lighting	US$25.4 million	In process
The Multilateral	Promoting of Appliance	Improve the energy efficiency of appliances	• Strengthening of regulatory and institutional framework	US$6.12 million	Complete

Institution	Program	Objective	Activities	Budget	Status
Fund (MLF), Global Environment Facility (GEF), United Nations Development Programme (UNDP)	Energy Efficiency and Transformation of the Refrigerating Appliance Market in Ghana	marketed and used through the introduction of a combination of regulatory tools such as Minimum Energy Performance Standards and Information Labels (S&L), and innovative economic tools.	› Design of certification, labeling and enforcement systems › Training and public outreach › Establishment of refrigerating appliance test facility › Used appliance collection and disposal facilities › Efficiency program evaluation and monitoring capacity development › Conduct of refrigeration appliance rebate and exchange program › Financial design of follow-up national market transformation programs	(MLF = US$1.198m ; GEF = US$1.722m ; UNDP-Ghana = US$0.2m; GoG =US$2m)	
Renewable Energy and Energy Efficiency Partnership (REEEP) with funding provided by UK and Norway	Performance Standards and Labelling for LED Lighting in Ghana	To develop, introduce and enforce energy performance standards and labelling to ensure high quality LED lamps in Ghana	› Compile all relevant data on existing technical performance standards and labelling schemes › Review LED standards developed in China and by Lighting Africa with support from REEEP › Develop appropriate technical performance standards and labels for LEDs for Ghana › Review of the draft performance standards and labelling with stakeholders and incorporate their input into the proposal › Transform technical performance standards into draft regulations › Solicit stakeholder input on draft regulations, make appropriate revisions, and pass regulations into legislation	€98,500	Completed
African Development Bank (AfDB)	Energy Efficiency Study And Development Of Regulatory Framework For Commercial And Public Buildings In Ghana	The project seeks to improve the energy use efficiency in buildings and reduce GHG emission through energy studies, standards and regulations, public education and capacity building.	› Study and data gathering mainly on energy consumption profiles of public/commercial buildings, identification of sources of energy wastage, identification of opportunities for energy savings and training of energy managers. › Stakeholder consultations and development of energy efficiency standards/regulations, public education and sensitization as well as capacity building for enforcement of the standards/regulations.	US $250,000	In process

4 ENERGY EFFICIENCY MARKET

4.1 Key Players in the Energy Efficiency Market

Table 12: Summary of Energy Efficiency Market Players

Sector	Type of Organisation	Name of Organisation	Description of Role and Involvement
Institutional (Public Sector)	Ministries, Departments and Agencies (MDAs)	Ministry of Energy	Formulation, implementation, monitoring and evaluation of energy sector policies.
		Energy Commission	The Energy Commission is the technical regulator of Ghana's electricity, natural gas and renewable energy industries, and the advisor to Government on energy matters. The Commission was established by the Energy Commission Act 541 of 1997 with the authority for the formulation and promulgation of standards and regulations for the energy sector. As such, it is the starting point for the formulation of energy efficiency standards. In addition to formulating regulations, the Commission is responsible for setting policy and procedures with regards to the continuing practicalities of enforcement. The Energy Commission has been the lead implementer of all publicly-led energy efficiency interventions since 2007.
		Ghana Standards Authority (GSA)	The GSA is the national standards body. Its mission is to contribute towards the strengthening of the Ghana economy and towards the enhancement of the quality of life for all her people through the promotion of standardization. The GSB was established in 1967, and its key services include: i) national standards development and dissemination; ii) testing; iii) inspection; iv) product certification; and v) destination inspection of imported high-risk goods. The GSB has been actively involved in the minimum energy performance standard for RAC, refrigeration and lighting appliances in Ghana. The GSB will work with the Customs, Excise and Preventive Service to ensure that quality standards are maintained for appliances coming into the Ghanaian market.
		Customs Division of the Ghana Revenue Authority (GRA)	The Customs Division is responsible for collection of Import Duty, Import VAT, Export Duty, Petroleum Tax, Import Excise and other taxes. The Customs Division ensures the protection of revenue by preventing smuggling by physically patrolling borders and other strategic points, examination of goods, and search of premises, as well as documents relating to the goods. In addition, the Customs Division performs agency duties on behalf of other government organizations and Ministries by seeing the enforcement of laws on import and export restrictions and prohibitions. Thus, the Division, in collaboration with the GSA, is responsible for the enforcement of energy efficiency standards in Ghana.
		Environmental Protection Agency (EPA)	The Environmental Protection Agency (EPA) is the leading public body for protecting and improving the environment in Ghana. It was set up (initially as the Environmental Protection Council) over 30 years ago and it has offices across Ghana working on and carrying out Government policy, inspecting and regulating businesses and reacting when there is an emergency such as a pollution incident.

Sector	Type of Organisation	Name of Organisation	Description of Role and Involvement
Private Sector	Energy Service Companies (ESCO)	The Ghana Energy Foundation	The Ghana Energy Foundation is a non-profit, private sector institution, committed to the promotion of energy efficiency and renewable energy. The Foundation specialises in offering energy efficiency and renewable energy solutions to the Ghanaian economy in general and to residential, industrial and commercial energy consumers in particular. The Energy Foundation has been involved in virtually all the major energy efficiency initiatives in Ghana since its establishment in 1997. Specifically, the Foundation was involved in the development and implementation of mandatory energy efficiency standards with regards to ACs, lighting and refrigeration, the CFL Exchange Programme and Refrigeration Exchange and Rebate Programme.
		AB Management	AB Management & Agency Ltd is an energy management firm and one of the few contract energy managers in Ghana. The company is involved in the installation of capacitors for power-factor correction in commercial and industrial facilities. Since 2001, AB Management has worked with over 166 companies in various energy efficiency measures such as Power Factor correction, the use of high frequency electronic ballasts, high efficiency motors, variable speed drives, and cooling systems.
	Energy Suppliers	Enclave Power Company	Enclave Power Company (EPC), which is private distribution company licenced by the Energy Commission to distribute power within the 120 acre Free Zone Enclave in Tema, an industrial city located 18 kilometres from Accra. Currently, EPC supplies electricity to over 50 customers within its operational area and this number is expected to exceed 80 within the next 2 years with a number of new companies at various stages of construction of their plants. EPC annual power sales is around 80 GWh.
Association	ESCO Association	Ghana Association of Energy Service Companies and Consultants (GHAESCO)[4]	Offers energy, related engineering services to industry and commerce in the country. The GHAESCO was formed to provide a strong network of local energy service specialists and companies to provide energy and related engineering services to industry and commerce in Ghana. The initial association membership was 30.
		The National Air-Conditioning and Refrigeration Workshops Owners Association (NARWOA)	The (NARWOA) is a nationwide Trade Association of over 5,000 owners of repairer workshops of ACs and refrigerators in Ghana. It was established in 1988, with its headquarters in Accra. The Association has a good track record as being well-organized and being interested in undergoing training for greater efficiency and to explore new market opportunities in their business.

[4] My checks with the Energy Foundation and Commission appear to suggest that the Association has become dormant and would have to be revived.

5 BARRIERS AND CHALLENGES

Table 13: Summary of Barriers to Energy Efficiency Implementation

Barriers	Applicable	Justification/Description	Potential Solutions
Regulations and legislative framework	Yes	Although there are EE regulations in place in respect of RAC, lighting and refrigeration and being enforced in Ghana, there are still quite a number of other appliances that are not covered by any regulations, with legislative backing. Even in cases where regulations exist, enforcement has been challenging leading to situation where sub-standard products and appliance still do make their way onto the market thereby undermining customer confident in efficiency products.	› New and enforceable regulations need to be developed for other appliances such as electric motors, etc. › Inspectorate division of the Energy Commission, the Ghana Standards Authority and the Customs Division of the GRA needs to be strengthened
Finance Mechanism	Yes	Currently there is a lack of effective and affordable financing models and mechanisms for providing efficient and sustainable financing for energy efficiency improvement programmes. There are very few (if any) financial institutions interested in funding EE interventions and products. Even when they are interested, borrowing rates and tenure of loans are not appropriate.	› Establishment of dedicated/special purpose energy efficiency funds; › Liaising with and supporting financial institutions to offer affordable and appropriate financing models for EE projects
Knowledge and Capacity	Yes	There is general dearth of knowledge on the part of consumers regarding energy efficiency opportunities and benefits. Very few studies presenting the market characteristics (type of technology and corresponding energy savings potential) have been conducted till date. Thus, awareness of the opportunities offered by the energy labeling system for household appliances and the associated energy savings is low among the general public and the retailers. This lack of information and awareness implies that both the demand and the supply for EE appliances are minimal. Furthermore, there is a shortage of a critical mass of trained and skilled personnel to install, operate, maintain and evaluate EE technologies. Furthermore, few people are skilled in energy management in the country. Additionally, there is no experience on how a structured enforcement program should be implemented, and there is no laboratory that could perform energy efficiency test on household appliances. Often, the laboratory equipment does not exist and when it exists, the human resources of the laboratory are not trained to perform the required tests according to international standard.	› Provision of training in installation, operating, maintenance and evaluate energy efficiency technologies › Capacity building in energy management
Transaction Costs	No	Could be a barrier but has not so far because of the limited number of non-donor funded projects on energy efficiency	

Barriers	Applicable	Justification/Description	Potential Solutions
Perceived Risk	Yes	Linked to the lack of knowledge on opportunities and benefits in EE.	
Energy Cost	Not really	This used to be a major barrier. However, the 2015 Tariff reviews pushed tariff to cost-reflective levels. Current tariff level are high enough (especially among non-residential and industrial customers) to provide incentives for the adoption of EE interventions	
Incentives to invest in EE	Yes	Apart from electricity pricing that has seen some upward adjustment to cost reflective levels, there are no other financial/non-financial incentives to invest in Energy efficiency interventions. The existing tariff structure offers some economic incentives (albeit limited) for consumers to manage their consumption. The tariff structure has bands and each band has its own end-user tariff. The more one consumes, the more he/she pays.	
Quality of appliances and products	Yes	Influx of cheap and poor quality appliances unto the market has always been a major challenge undermining energy efficiency since certified quality of energy efficient products on the market are absent. This in spite of the efforts from the GSA to define standards for some of the products in order to ensure their quality.	› Introduction and enforcement of MEPS

6 ENERGY EFFICIENCY POTENTIAL

Table 14: Summary of EE Potential per Sector in the Country

Sector	Potential	References	Possible Activities and Implementation Capacity
Residential	› Lighting (430 GWh/year) › Room Air Conditioners (950 GWh/year) › Refrigeration (550 GWh) › Approximately 6 TWh/yr to achieved by 2030 if MEPS is developed for about 8 household appliances	› Source: The UNEP/GEF en.lighten initiative Country Lighting Assessment, 2012 › The "Ghana Residential Energy Use and Appliance Ownership Survey: Final Report on the Potential Impact of Appliance Performance Standards in Ghana" › Energy Commission, 2006, Baseline Study on Energy Consumption of Domestic Refrigerators in Ghana › LBNL, 2012. Potential Savings from Cote d'Ivoire, Nigeria and Senegal (https://eetd.lbl.gov/sites/all/files/ecowas_buenas_report101012.pdf)	› Develop standards and labels for appliances such as television, fans, and electric motors › Technically update existing standards on lighting, refrigeration and RAC › Lighting retrofit – replacing CFLs and fluorescent tubes with Light Emitting Diodes (LEDs) › Accelerate replacement of inefficient refrigerators and deep freezers Virtually all the activities are on-going or have been implemented in the past so state and allied institutions have the capacity to implement.
Commercial/ Institutional	22.5%	Deloitte and Econoler (2015), Opportunities for the SUNREF programme in Sub-Saharan Africa – Draft Phase 2 Interim Report – Ghana prepared for the Agence Française de Développement	› Delamping to comply with standards, but not more; › Changing lamps to more energy-efficient alternatives (incandescent to CFL, 40WT12 to 32WT8 or T5 fluorescent lamps with electronic ballasts, LED based lighting, etc. › Controlling systems using scheduling, dimming, as well as presence and/or light sensors › Changing fixtures to reflective fixtures with better performance › Replacement of inefficient compressors; › Retrofits of condensing systems (including cooling towers and evaporative condensers); › Replacement of existing chillers by more energy-efficient alternatives › Installation of premium or high-efficiency motors on pumps and blowers

Sector	Potential	References	Possible Activities and Implementation Capacity
			› Various control modifications on centralized systems, such as conversion to variable volume ventilation systems, use of free cooling and installation of local electronic temperature sensors; › Replacement of inefficient portable AC systems by energy-efficient window units or split systems › Replacement of localized AC units by a centralized system
Industrial	19%	Deloitte and Econoler (2015), Opportunities for the SUNREF programme in Sub-Saharan Africa – Draft Phase 2 Interim Report – Ghana prepared for the Agence Française de Développement	› Replacement of boilers and furnaces by more energy-efficient alternatives › Installation of economizers, heat exchangers, flash steam recovery systems › Fine-tuning of the controls in the furnace or boiler room › Optimization of heat or steam distribution systems and replacement of defective steam traps when required › Retrofitting and installing insulation material on furnaces, boilers, hot water tanks and steam pipes › Retrofitting existing motors and driving systems using variable speed drives in systems with variable loads and premium efficiency motors › Replacing oversized motors and pumps by smaller equipment › Lighting retrofitting › Replacement of the air compressors by other more energy-efficient compressors › Installation of Automatic Capacitor Banks

7 CONCLUSION

Table 15: Observations and General conclusions

Sectors to Favor	Activities and/or Technologies to favor	Explications
Residential	› Lighting retrofit – replacing CFLs with LEDs › Replacement of old and inefficient refrigerators › Development of new standards for other household appliances	› The residential load is growing at an alarming rate and something ought to be done about. › Ghana has gained a lot of experience in the development of S&L for the appliances being tackled thereby requiring less effort (technically and institutionally) in scaling-up or replicating. › There are on-going initiatives in these areas that could be piggy-backed. › Clear national policy and measures regarding these activities.
Industrial	› Fuel switching for power generation › Conversion of simple-cycle thermal plants into combined-cycle plants › Reduction in technical losses › Improvements in industrial processes and replacement of obsolete and inefficient technologies in industries as indicated in Table 9	› Electricity supply, which accounted for 10.1% of national GHG emissions in 2010, is projected to contribute 28.7% and 35.9% of emissions by 2020 and 2030 respectively in a business-as-usual scenario. There is therefore a lot of efficiency improvements to be made in this area › The discovery of indigenous gas resources and the influx/proliferation of Independent Power Producers (IPPs) makes it pragmatic and cost-effective intervention › Clear national policy and identification of efficiency improvements in electricity supply as one of the Intended Nationally Determined Contributions (INDC) › Relatively high electricity tariff for industrial customers provides incentives for industry to adopt efficiency measures
Transport	› Scale of Bus Rapid Transit (BRT) system to major cities in Ghana › Vehicle Fuel Efficiency S&L › Introduction of alternative fuels such as biofuels and compressed natural gas (CNG) as transport fuel	› Transportation sector, which contributed 15.7% of national emissions in 2010 is projected to contribute 39.5% and 38.9% of national emissions by 2020 and 2030 respectively in a business-as-usual scenario › Clear policy support and pilot BRT currently underway › Discovery of indigenous natural gas offers the opportunity for fuel-switching

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Annex 1: Mitigation Policy Actions and emission reduction actions[11]

INDC Policy Actions	Programme of Action	Supporting national policy & measures	Status	Investment Needs (mil $)	Co-benefits
Scale up renewable energy penetration by 10% by 2030	Increase small-medium hydro installed capacity up to 150-300MW	• National Energy Policy • National renewable energy Act (Act 832). • Set up feed-in-tariff for renewable energy technologies. • Established of national renewable energy fund • Design renewable energy purchase obligation. • Net metering scheme for households	Conditional	2,214	• Job creation opportunities through installation and maintenance of about 127.5 million man hours. • Reduced consumption of fossil fuel consumption for power generation. • Increased electricity access to rural communities and contributed to realize energy security. • The electricity demand saving of about 200MW
	Attain utility scale wind power capacity up to 50-150MW				
	Attain utility scale solar electricity installed capacity up to 150-250MW				
	Establish solar 55 mini-grids with an average capacity of 100kW which translates to 10MW				
	Scale up the 200,000 solar home systems for lighting in urban and selected non-electrified rural households				
Promote clean rural households lighting	Increase solar lantern replacement in rural non-electrified households to 2 million.	• Sustainable Energy Action Plan • National bioenergy strategy • Phasing out fossil fuel subsidies		300	• Avoided GH¢74 million subsidy on kerosene annually. • Kerosene savings to the nation of 60,000liters, 150,000liters and 390,000liters.

[11] Mitigation actions were selected based on the following key considerations. (1) Government is commitment (policy and financial wise) to get mitigation actions implemented and alignment with government priorities; (2) Enough baseline data exist with clear set targets that can be used for the GHG emissions modeling and assessment of co-benefits; (3) It is possible to estimate investment requirements(estimate pragmatic and reasonable budget) with clear sources of funding; (4) It is possible to estimate sustainable development benefits of the actions; (5) Technology and know-how are available to be deployed in the Ghanaian market; (6) Mitigation actions are already part of the list of 55 NAMAs submitted to the UNFCCC in 2010 and (7) There are existing analytical tools that can be adapted to suit Ghana's unique national circumstance.

Expand the adoption of market-based cleaner cooking solutions	Scale up adoption of LPG use from 5.5% to 50% peri-urban and rural households up to 2030. Scale up access and adoption of 2 million efficient cook stoves up to 2030	• Sustainable Energy Action Plan • National Natural Gas Master Plan. • National LPG Programme		0.6 50	• 39,500 hectares of woodland is saved from degradation. • Reduction in indoor pollution resulting from wood fuel usage. • Reduction in smoke related respiratory and eye diseases • Reduction in household cooking fuel expenditure • Job creation through the manufacture and sale of the efficient stoves
Double energy efficiency improvement to 20% in power plants	Scale up 120 MSCF[12] natural gas replacement of light crude oil for electricity generation in thermal plants.	• National Natural Gas Master Plan.	Unconditional	1,000	• Depending on demand scenarios, savings are estimated to be between US$67 million and US$610 million. • Projected fuel cost savings over the lifetime of the project are expected to be between US$94 million and US$109 million, based on the mid-level gas demand projection. • Income tax - Projected income taxes to be paid by WAPCo to Ghana over the lifetime of the project is in the range of US$466 million to US$588 million.
Scale up Sustainable mass transportation	Expansion of inter and intra city mass transportation modes (Rail and bus transit system) in 4 cities [13]	National Transport Policy	Conditional	1,201	• Number of trips by public transportation increased by 10% in the 4 cities. • Number of NMT trips increase by 5% in intervened areas.

[12] Million standard cubic feet

[13] This is a flagship transformational change INDC action but it is not included in the mitigation actions. Detail analysis on the scope and scale of the action will be provided before 2020.

					• Reduction in travel time by at least 8 minutes per trip by public transport. • Traffic congestion levels decreased.
Promote Sustainable utilization of forest resources through REDD+	Continue 10,000ha annual reforestation/afforestation of degraded lands	National Forest and Wildlife Policy. National plantation development strategy	Unconditional	1,050	• Annual 29,000 jobs created. • Annual production of 370 metric ton of staple food
	Double 10,000ha annual reforestation/afforestation of degraded lands translating to 20,000ha on annual basis.		Conditional	1,750	
	Support enhancement of forest carbon stocks through 5,000ha per annum enrichment planting and enforcement of timber felling standards.	National Forest and Wildlife Policy. Timber resource utilization regulation	Conditional	60	• Biodiversity conservation
	45%[14] emission reduction through result-based emission reduction programme in cocoa landscape.	National Forest and Wildlife Policy National REDD+ strategy	Conditional	2,067	• Increase 20,000 cocoa farmer incomes by doubling the average yield per hectare. • In reducing deforestation and degradation, the program will help to maintain and conserve the biodiversity that is found within the cocoa-forest landscape.
	Wildfire management in the transition and savannah dry lands in Ghana		Conditional	26	• Reduce emissions of short-lived climate pollutants. • Reduce deforestation and improve biodiversity conservation especially in the drylands. • Improve degraded lands for productive use.

[14] Provisional targets. Forest reference level is limited to avoided deforestation. New estimates will be submitted before 2020.

Adopt alternative urban solid waste management	Improve effectiveness of urban solid collection from 70% to 90% by 2030 and disposed all to an engineered landfills for phase-out methane recovery from 40% in 2025 to 65% by 2030	• National sanitation strategy. • National bioenergy strategy. • National renewable energy Act (Act 832) • Environmental Protection Act (Act 490) • Environmental Assessment Regulation (LI. 1652) • Sustainable Energy Action Plan.	Conditional	15	• Job creation of about 9 million man hours for 15 years based 250 people working for 8 hours /day. • Improved urban sanitation and waste management. • Improved agricultural yield through the availability of organic fertilizer. • Reduced inorganic fertilizer bill to government
	Scale up 200 institutional biogas in senior high schools and prisons nation wide			5	
	Double the current waste to compost installed capacity of 180,000tonne/annum by 2030[15].			60	
Double energy efficiency improvement to 20% in industrial facilities	Scaling up of installation of power factor correction devices in 1,000 commercial and industrial facilities (capacitor banks).	• National Energy Policy • Power factor surcharge for bulk electricity consumers. • Sustainable Energy Action Plan.	Conditional	8.4	• Reduction in electricity demands and expenditure. Direct electricity cost saving to consumers. With an average monthly maximum demand savings of $ 300 avoided power factor surcharge.
Green Cooling Africa Initiative	Abatement of fluorinated-gases (HFC-22 and HFC-410) from stationery air-conditioners	• National ODS phase-out programme. • Management of ODS and product regulation, 2005 (LI. 1812)	Conditional	0.3	• Phase-out ozone depleting substances.