The Gold Standard
Premium quality carbon credits

THE GOLD STANDARD:
Project Design Document for Gold Standard Voluntary Offset Project

Improved Household Charcoal Stoves in Ghana

(GS-VER-PDD)

Developed by E+Carbon according to the "Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes, Version 1."

Version 4.1

For more information about the Gold Standard, please contact The Gold Standard:

http://www.cdmgoldstandard.org
info@cdmgoldstandard.org

phone +41 61 283 09 16
fax +41 61 271 10 10

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VOLUNTARY OFFSET PROJECTS

PROJECT DESIGN DOCUMENT FORM (GS-VER-PDD)
Version 01 - in effect as of: January 2006)

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SECTION A. General description of project activity

A.1 Title of the project activity

Title: Improved Household Charcoal Stoves in Ghana
Version: 4.1
Date: 8 September, 2009

PDD Version history:
Version 1.0 – pre-validation
Version 2.0 – validation, uploaded to GSP
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Version 4.0-4.1 - Registration

A.2. Description of the project activity

Fuelwood and charcoal meet approximately 75% of Ghana's fuel requirements[1]. Approximately 69% of all urban households in Ghana use charcoal[2]. The annual per capita consumption is approximately 180 kg; the total annual consumption is about 700,000 tones. Accra and Kumasi, the two largest cities in Ghana, account for 57% of the charcoal consumed in country[3].

The project described here will reduce greenhouse emissions by disseminating fuel-efficient charcoal stoves. The project is based on pilot work by Toyola Energy Limited (TEL), Ghana. TEL was established in 2003. It is owned and managed by highly educated and trained entrepreneurs. TEL was part of 50 informal metal artisans selected and trained by EnterpriseWorks Worldwide[4] to fabricate the "GYAPA" charcoal efficient cook stoves. More recently, TEL renamed their product. Toyola's stove is now marketed and sold under the name "Toyola Coalpot"[5], which is the stove being introduced in this project. The stove also has several differentiating design features from the original GYAPA that allow it to be uniquely identified in the field. See annex 4 for specific design features that allow the stoves to be uniquely identified.

Four types of stoves will be marketed on a large-scale under the auspices of the project:

a. improved fuel-efficient household charcoal stoves (small)
b. improved fuel-efficient household charcoal stoves (medium)
c. improved fuel-efficient commercial charcoal stoves (small)
d. improved fuel-efficient commercial charcoal stoves (large)

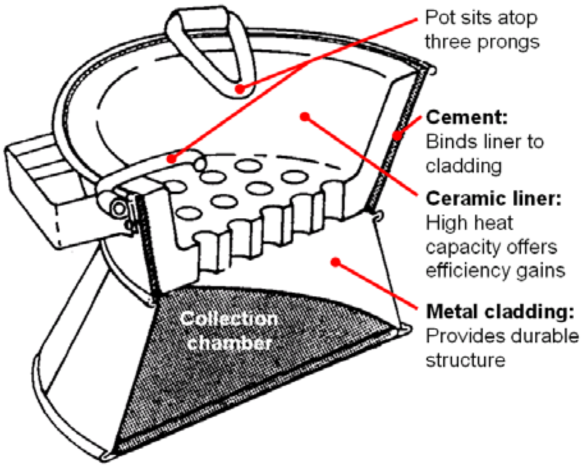
Carbon offset projections in this PDD assume that all stoves are the medium household size stove. Although these other stoves accounted for less than 5% of total sales in December, 2007, and the overwhelming majority of stove sales today are the medium household, Berkeley Air Monitoring Group has identified fuel savings adjustment factors for TEL's other stoves to accurately account for their emissions reduction in future monitoring reports. The other

[1] http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=GHA&subj=5
[2] FASO Ghana report: Forestry Sector Outlook Studies - FOSA/WP/12, http://www.fao.org/docrep/003/ab567e/AB567E01.htm
[3] http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=GHA&subj=5
[4]Enterprise Works Worldwide is a global NGO that fights poverty through business development and market awareness programmes.
[5]For simplicity, the term "Toyola Coalpot" is used to describe any stove similar to the Jiko design sold in Ghana by TEL, including before TEL began marketing under this name. The term Gyapa is used to describe any stove similar to the Jiko design sold in Ghana by companies other than TEL. The name of TEL's stove changed from Gyapa to Toyola Coalpot in July, 2008.

three models are growing in sales proportion and could become significant later in the project. See annex 6 for an explanation of these adjustment factors.

The improved charcoal stove (Toyola Coalpot) reduces fuel consumption by introduction of a ceramic liner that increases combustion efficiency and retains heat. The Toyola Coalpot stove consists of hourglass shaped metal cladding with perforated interior ceramic liner that allows ash to fall to the collection chamber at the base. A thin layer of cement is placed between the cladding and the liner to bind the two. During use, a single pot rests at the top the stove. Based on the fuel savings number determined during the Kitchen Performance Tests (KPTs) performed by Berkeley Air Monitoring Group, the Toyola Coalpot is 33% more fuel-efficient than traditional methods[6], though a ceramic liner has the potential to improve fuel-efficiency by up to 50%[7]. See diagram below for more technical details:

Cross Section of Toyola Coalpot



While these stoves will significantly reduce greenhouse gas emissions, they simultaneously provide co-benefits to users and families in the form of relief from high fuel costs, reduced exposure to health-damaging airborne pollutants, faster cooking (resulting in time-savings), and increased cleanliness and convenience. Finally, they curb deforestation by decreasing demand for charcoal.

The Toyola Coalpot stove is a variant of the Kenya Jiko stove, as is the GYAPA stove. The GYAPA stove is well-recognized in Ghana due to a three-year awareness and marketing campaign (2002-2005) sponsored by the United States Agency for International Development (USAID) and implemented by EnterpriseWorks Worldwide. Although the Toyola Coalpot name has only recently been introduced, TEL's management are confident that consumers will trust the product since Toyola is a leading manufacturer and distributor of efficient stoves in Ghana.

TEL has increasingly expanded to new markets in Ghana that reach beyond the areas where marketing was performed under the aforementioned program. Moreover, TEL's market expansion suggests that customers are more likely to purchase efficient stoves based on face to face interaction and informal networks rather than centralized marketing and awareness raising campaigns. This supports TEL's decentralized, dispersed sales model. TEL's decentralized sales model has increasingly proven that working capital, which facilitates access to remote markets, is the primary barrier to industry growth.

Between December 2006 and June 2007, TEL sold 131 commercial and 7346 residential stoves. In July and August 2007, an additional 3464 stoves (342 commercial and 3122 residential models) were sold, enabled entirely by E+Co's investment, which was based on a premise of future carbon revenues. Plans were formalized in mid-2007 to

[6] See Berkeley Air Monitoring Group's baseline assessment in Annex 6 of this report - (1.5 kg – 1.0 kg)/1.5 kg = 0.33
[7] http://www.shellfoundation.org/index.php?newsID=419

secure carbon finance with a view to a further expansion effort that would allow the Toyola Coalpot stove to be sold at affordable prices. For sales and offset projection purposes, we assume that stoves are installed at a consistent rate throughout the year and that 20% of the stoves sold cease to be used each year. See section D and Annex 2 for complete sales projections and detailed carbon calculations.

The operational lifetime of each improved stove is an important factor, since greenhouse gas (GHG) emission reductions are dependent not on the sale of an improved stove for use in a kitchen operating an inefficient stove, but rather they are dependent on the number of months or years the improved stove is in daily use. The actual drop-off in customer numbers is expected to be less than 20% per year due to quality assurance measures, and will be monitored carefully by the project. Actual drop-off rates will be substituted for this conservative estimate of 20%. Similarly, the potential drop-off in performance of aging stoves will be measured and the results applied to GHG emission reduction calculations.

Currently, inefficient and polluting cooking regimes are deeply entrenched in Ghanaian culture. Using carbon finance, this project aims to break this trend and move large populations away from conditions under which GHG emissions are unacceptably high, indoor air pollution is harmful to health and environmental effects from deforestation are significant.

Carbon finance provides a means to increase affordability of stoves by significantly lowering their retail price, while introducing quality guarantees and an ongoing monitoring and evaluation component. The project proponents recognize that efficient charcoal stoves are a medium term solution, and future plans could include using carbon revenues to promote the production of green charcoal as a way to make cooking in Ghana completely sustainable.

TEL has future plans to introduce a three year warranty, which will be funded by carbon revenues. This will introduce a new set of quality expectations among consumers and so shift the critical mass of prevailing practice away from inefficient cooking with its extreme environmental and health effects, to new widespread prevailing practice involving significantly reduced GHG emissions and less polluted kitchens. The quality assurance system will extend the useful lives of stoves and maintain performance levels. This strategy will help secure customer loyalty and strengthen an overall shift of customer preference toward high efficiency stoves. The effect will be to galvanize competition in the same direction, so securing widespread dissemination of low-emission cook stoves.

Table A.2 Projected Annual Sales and Annual Offsets

Fuel-Specific Parameters									Stove sales and Usage P
	Type of fuel	Avg. NRB	EF CO2	EF CH4	EF N2O	Baseline Fuel Consumption	Project Fuel Consumption	Average Fuel Savings	Initial Sales (1st year)
		%	tCO2/t_fuel	tCO2e/t_fuel	tCO2e/t_fuel	kg/hh_day	kg/hh_day	kg/hh_day	Annual Sales Growth (%)
Biomass 1	**Charcoal ***	73.00%	5.106	1.141	0.096	1.50	1.00	0.50	Avg. Annual Leakage (%)
Biomass 2	**Wood**	73.00%	1.747	0.401	0.054	1.08	0.87	0.21	KS Adjustment Factor
Biomass 3	0	0.00%	0	0	0	0.00	0.00	0.00	Avg. Annual Sales
Alternative fuel 1	0	-	0	0	0	0.00	0.00	0.00	Avg. Stove lifetime (yrs)
Alternative fuel 2	0	-	0	0	0	0.00	0.00	0.00	
Alternative fuel 3	0	-	0	0	0	0.00	0.00	0.00	

Annual Usage and Sales Rates										
	Project Year	1	2	3	4	5	6	7	8	9
	Calendar Year	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stove Usage Rate:	(% in use at end of year)	90%	70%	50%	30%	10%	0%	0%	0%	0%
	Annual Sales:	**18,000**	**19,800**	**21,780**	**23,958**	**26,354**	**28,989**	**31,888**	**35,077**	**38,585**

Conservative Project Emission Reductions (tCO2e)							**Fuel Savings Adjustment Factor:**		**1.00**	**Leakage:**
Carbon Flows		**Project Year**								
Offset Vintage	**Stoves disseminated**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
2007	18,000	8,791	16,223	12,935	9,236	5,537	2,306	457	0	0
2008	19,800	0	9,724	17,792	14,229	10,160	6,102	2,525	503	0
2009	21,780	0	0	10,696	19,572	15,652	11,200	6,688	2,778	553
2010	23,958	0	0	0	11,765	21,529	17,257	12,280	7,356	3,056
2011	26,354	0	0	0	0	12,942	23,741	18,924	13,508	8,092
2012	28,989	0	0	0	0	0	14,314	26,037	20,816	14,859
2013	31,888	0	0	0	0	0	0	15,745	28,641	22,898
2014	35,077	0	0	0	0	0	0	0	17,320	31,505
2015	38,585	0	0	0	0	0	0	0	0	19,052
2016	42,443	0	0	0	0	0	0	0	0	0
0	**Carbon Volumes (tCO2e)**	**8,791**	**25,947**	**41,424**	**54,802**	**65,820**	**74,921**	**82,656**	**90,922**	**100,014**
									5-year total =	**196,783**
									10-year total =	**655,629**

* Charcoal emissions factors include emissions from both production and consumption of charcoal.

The sustainability analysis assesses the project in terms of environmental and sustainable development impact. An overall score, according to the Sustainable Development Matrix, is achieved as follows:

Sustainable Development Matrix		Score (-2 to 2)[8]
Local/Regional/global environment		
	Water quality and quantity	0
	Air quality*	2
	Other pollutants*	0
	Soil condition	0
	Biodiversity	1
Sub-total		3
Social sustainability and development		
	Employment*	1
	Livelihood of the poor*	2
	Access to energy services*	1
	Human and institutional capacity	1
Sub-total		5
Economic and technological development		
	Employment (numbers)*	1
	Balance of Payments (sustainability)	0
	Technological self-reliance	1
Sub-total		2
TOTAL		10

* Indicators that will be monitored as part of the monitoring program – see below for more details.

Sustainable Development Assessment:

Greatest Positive Impacts

1. Air Quality: Mothers and children will be exposed to fewer hazardous air pollutants through reduced emissions of carbon monoxide and fine particulate matter. Air pollution from cooking with solid fuel is a key risk factor for childhood acute lower respiratory infections (for example, pneumonia) as well as many other respiratory, cardiovascular, and ocular diseases. In Ghana, exposure to indoor air pollution (commonly measured by the pollutants carbon monoxide and fine particles) is responsible for the annual loss of 502,000 disability-adjusted life-years (DALY)[9]. The DALY is a standard metric used by the World Health Organization (WHO) to indicate the burden of death and illness due to a specific risk factor. The WHO also estimates that exposure to indoor air pollution is responsible for 16,600 deaths per year in Ghana.

[8] Evan Haigler, Executive Director of the Center for Entrepreneurship in International Health and Development (CEIHD), can be contacted as an expert to confirm the scores in the SD Matrix.

[9] World Health Organization, December 2004, at http://www.who.int/healthinfo/bod/en/index.html

**Monitoring Indicator*: Indoor air pollution is assessed qualitatively in the Kitchen Survey and may be monitored quantitatively during the project by measuring ambient carbon monoxide and particulate matter concentrations in households with improved and unimproved cookstoves.

2. Livelihood for the poor: Livelihood circumstances will be improved since the improved stoves reduce fuel costs. On average, a medium household stove user saves about $24 per year[10] for an initial investment of about US$8[11] for the Toyola Coalpot stove (the payback period is generally 4 months per stove). The Toyola Coalpot stove contributes to reduction in energy budgets on charcoal by 33%[12].

   **Monitoring Indicator*: Monetary savings due to reduced fuel consumption will be monitored throughout the project in the ongoing Kitchen Surveys. Cost savings will be self reported by end users as well as calculated based quantitative fuel savings found in the follow-up Kitchen Test and average local fuel prices at that time.

Additional Positive Impacts

3. Biodiversity: Biodiversity will be improved through the stove program, reducing pressure on remaining forest reserves. By reducing charcoal consumption the demand for charcoal will be reduced and trees will be left standing. Assuming 18,000 stoves sold per year, the project would avoid the cutting and burning of 13,140 tons of wood in just one year[13].

4. Employment: The improved stoves give rise to employment opportunities for enterprises manufacturing, distributing, retailing, and maintaining the stoves (though this may be offset by reduced employment for charcoal makers and sellers). This indicator refers to both quantity and quality of employment. From a quantitative standpoint, at the time of the project start date, the company was composed of the two managers with no employees. As of the end of 2008, Toyola was employing 136 people[14]. From a qualitative perspective, Toyola adhere's to, and in many cases, exceeds Ghana's labor laws. Toyola does not employ anyone under age 18, a principle to which many Ghanaian firms do not adhere. Toyola provides steady, reliable and reasonable waged employment. In fact, they have raised wages as the company expands and enjoys greater success. They regularly train new workers in the skills of metal working and ceramics. The stakeholder consulstation highlighted the need for workers to use earplugs to mitigate hearing damage. Toyola now distributes ear plugs to workers for this purpose.

   **Monitoring Indicator*: Changes in employment at TEL will be monitored directly and indirect job creation will be estimated based on increased sales volumes and known capacity growth among dealers, distributors, retailers, etc. Employment quality will be monitored to ensuring that Toyola continues to adhere to the basic principles outlined above, as well as continuing to use earplugs during metal working.

5. Access to energy services: Urban householders will have improved access to energy (estimated at 30-60% more effect from the same fuel).

   **Monitoring Indicator*: The project will monitor improved access to energy services by extrapolating based on total sales and average household size.

[10] Charcoal price of 6 Ghana Cedi/46 kg bag of charcoal taken from "Comparative Cost of Energy for Cooking In Ghana." Wisdom Ahiataku-Togobo, UNDP/GOG Household Energy Programme, January, 2007.

[11] Personal interview with Suraj Wahab from Toyola.

[12] Based on Berkeley Air Monitoring Group's baseline KPT.

[13] Based on Berkeley Air Monitoring Group's baseline KPT and 8 tons of wood per ton charcoal

[14] E+Co Monitoring Evaluation Report for Toyola, Feb, 9 2009

6. Human and institutional capacity: Human capacity is raised through the business development component of the project. Contact details for several artisans are listed in the Stakeholder Meeting Minutes (Annex 5) and they may be contacted to examine capacity increases arising directly from carbon finance over the course of the project.

7. Technological self-reliance: The introduction of locally manufactured technology with optimized energy efficiency helps to build technological self-reliance. Contact details for several artisans are listed in the Stakeholder Meeting Minutes (Annex 5) and they may be contacted to examine increases in technological self-reliance arising directly from carbon finance over the course of the project.

Neutral Impacts

8. Soil condition and water quality and quantity: The cookstove manufacturing process is environmentally friendly, as evidenced by E+Co's environmental assessment of TEL's business practices prior to pursuing carbon finance as a potential revenue stream.

9. Balance of payments: Not applicable. This indicator is not crucial for an overall positive impact on sustainable development compared with some of the other more central indicators highlighted here. As outlined in the GS VER guidelines, tracking this indicator is not necessary.

10. Other pollutants: Although pollutants are not expected to be a negative impact of the project, to maintain consistency with other projects and as per instructions from Gold Standard, this issue will be monitored throughout the course of the project.

**Monitoring Indicator*: The project will monitor whether paint, paint thinner and other manufacturing waste is dealt with and disposed of properly throughout the course of the project.

Negative Impacts

No known negative indicators arise from the project activities.

A.3. Project participants:

Name of Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Ghana	Toyola Energy Limited (TEL)	No
United States	E+Carbon	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

The project promotes sales of improved charcoal stoves in urban, peri-urban and rural communities in Ghana. The company's distribution network is expanding to cover major towns and market centers in and around the Greater Accra Region, Eastern Region, Ashanti Region and Central Region.

The primary charcoal production areas are in the Brong Ahafo region. According to Nketiah et al.[15], 60% of the charcoal supplied to Accra is sourced from Brong Ahafo, 25% from the Afram Plains, 10% from Volta region and approximately 10% from Central region. In the Brong Ahafo region, large scale charcoal production centres are located in Kitampo, Atebubu and Nkoranza. Apart from some producers in Kumasi and Mim who utilize wood residues from sawmills for charcoal production, live trees are used as the main source of wood for charcoal. The majority of charcoal producers are the Sissalas, an ethnic group from the Upper West region of Ghana. Typically, they use the earth mound method; this method is inefficient and has a carbonization rate of eight tons of wood to one ton of charcoal.

The over-dependence by most of the population on charcoal and fuelwood as energy sources has heightened the threat of deforestation and desertification in many parts of the country[16]. As the sources in the forest and savannah belt become depleted, other parts of the country will likely become sources for charcoal.

A.4.1.1. Host Party(ies):

Toyola Limited Enterprise (TEL), Ghana.

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

A.4.1.3. City/Town/Community etc:
TEL's geographical target market is expanding quickly in and around the Greater Accra Region , Eastern Region, Ashanti Region and Central Region.

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

TEL is the implementing organization and will conduct the project from its offices in Sapeiman in the northern peripheral of the Greater Accra region of Ghana. TEL and E+Carbon have implemented a system of rebate cards that collects end user personal information, enabling anyone to identify which customers have purchased stoves from TEL versus other stove market players in Ghana.

[15] Nketiah, K. S., E. B. Hagan and S. T. Addo. 1988. The Charcoal Cycle in Ghana – A Baseline Study. Report Prepared for UNDP, Accra, Ghana
[16] Atakora, S. Biomass Technologies in Ghana. Kumasi Institute of Technology and Environment (KITE). Accessed at: http://www.nrbp.org/papers/046.pdf

Contact Person(s): Erik Wurster, Carbon Finance Officer,
E+Carbon
383 Franklin St.
Bloomfield, NJ 02446,
Tel: +1.917.225.0125
Email: erik.wurster@eandco.net

Mr. Suraj Wahab Ologburo
Sarpeiman Village
Greater Accra Region,
Accra, Ghana.
Mobile tel: +233 24 548 2842
Email: toyolaenergy@yahoo.com

A.4.2. Size of the project:

Large-scale (more than 60,000 tons of CO2e saved per year)

A.4.3. Category(ies) of project activity:

A.2. Domestic Energy Efficiency

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed 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:

For full additionality rationale according to CDM additionality tool version 5.2, see section B.3.

No ODA funding is being used to purchase VERs and a confidential excerpt from E+Carbon's sales contract for all VERs generated can be provided upon request as a confidential annex to support this statement.

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

Years*	Annual estimation of emission reductions in tons of CO2e
2007-08	8,791
2008-09	25,947
2009-10	41,424
2010-11	54,802
2011-12	65,820
2012-13	74,921
2013-14	82,656
2014-15	90,922
2015-16	100,014
2016-17	110,332
Total emission reductions (tons of CO2e)	655,629
Total number of crediting years	10

Annual average over the crediting period of estimated reductions (tons of CO_2e)	65,563

* Years begin and end on 31 August.

SECTION B. Application of a baseline methodology

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

This project reduces greenhouse gas emissions by facilitating significant savings in the use of non-renewing biomass. This Project Design Document follows the approach laid out in the Methodology titled "Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes, Version 1."

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

Taking the applicability criteria outlined in the methodology in turn, the methodology is applicable to the project activity because:

1. Low emissions cookstoves are replacing a relatively high-emission baseline scenario, as evidenced by the results of the baseline study conducted by Berkeley Air Monitoring Group, which quantifies the baseline scenario. Moreover, the project employs a system whereby end users are offered an additional discount on an efficient stove if the purchase is accompanied by surrendering a functioning inefficient stove of roughly similar capacity. This provides an incentive to more quickly phase out inefficient stove use. Surrendered inefficient stoves are destroyed and sold for scrap metal to avoid them being resold into the market and used again. The initial discount is an additional 20% below the posted price, however, Toyola reserves the right to adjust this rate based on market conditions.
2. The project boundary can be and is clearly defined in section B.4. of this PDD.
3. The stoves counted are not part of any other voluntary or compliance carbon finance project. To account for other projects occurring in the same region, double counting is avoided by E+Carbon's legally robust system of 2nd tier ERPAs, whereby all participants in the efficient stove industry with whom TEL does business are asked to sign contracts that would reveal any possible double counting. A full paper trail of all ownership rights to emissions reductions can be produced, down to the end user level. TEL has developed a supply chain the is independent from any artisans that are working with other projects within the project boundary. Finally, Toyola's stoves are uniquely identifiable in the field, as outlined in annex 4.
4. The project activity is limited to the stove sales within Ghana. Any international stove sales are eliminated from the project activity.
5. There are no kitchens in the project activity that have more than 10 stoves per kitchen. Moreover, each stove has less than 50kW total output , as outlined in the calculations below:

Wood and Charcoal Net Calorific Values (IPCC 2006 GL)			
	NCV (TJ/Gg_ch or MJ/kg_ch)	lower 95%	upper 95%
Wood / Wood waste	15.6	7.9	31
Charcoal	29.5	14.9	58

Sample calculation (for medium household size stove)
NCV charcoal (MJ/kg) * thermal efficiency (%) * daily fuel consumption (kg/day) =29.5 MJ/kg * 0.35 * 1.0 kg/day = 10.325 MJ/day
10.325 MJ/day * 1 day/86,400 seconds *1000 KJ/MJ = 0.26 KJ/sec = 0.26 kW output

Stove size	Fuel consumption (kg/day) per fuel adjustment factors	Thermal capacity (kW)
Large commercial	1.4	0.17
Small commercial	1.2	0.14

Medium household	1.0	0.12
Small household	0.5	0.06

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

1. Determine customer groups or "clusters"

Step 1.1: Establish a pilot Sales Record

A pilot sales record was established by collecting the contact information of TEL customers using rebate cards. Rebate cards are completed by all TEL customers, which include end user contact information.

Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes

Berkeley Air Monitoring Group examined initial fuel mixture and kitchen regimes prior to determining possible clustering definitions. The entire Baseline Monitoring Study and Report was prepared by Berkeley Air Monitoring Group to avoid any conflict of interest in measurements that are central to emission reduction numbers and overall project profitability.

Step 1.3: Analyze renewability status of wood-fuels

1.3.1 Quantify non-renewable biomass

Non-renewable biomass baseline (NRBB) research is typically performed via desk research combined with visits to local experts in forestry and energy. Interviews and site visits held in-country generate the data used in the quantitative determination of the percent non-renewability in the area.

Between June 13 and June 22, 2008 the Berkeley Air field team conducted NRBB research on the fuel supply basin in Ghana. In particular, this research was performed to determine to what extent the project population's use of woody biomass for charcoal is not balanced by re-growth in the supply area.

See the baseline study performed by Berkeley Air Monitoring Group in annex 6 for a full overview of the sources consulted and the methodology employed.

(a) Establish supply area, and annual increment

Fuel supply area (A):

The wood that meets the fuel needs of the inhabitants of the Greater Accra and Eastern regions is harvested from forest stands and savannah across the country, including specifically: the Afram Plains, Brong Ahafo, Volta, and the Eastern and Central Regions. The map on the following page of Ghana's different regions highlights the regions from which biomass is currently sourced.

National, as opposed to supply basin-specific, numbers from the FAO[17] are used in the calculation because there is a dearth of data on the production and harvest of woodfuel within the specific supply basin in which we are interested. As the FAO notes, "[d]espite several past attempts at improving biofuel information systems in Africa, woodfuel information is still very scarce or [of] poor quality."[18] Because the wood that meets the fuel needs of the inhabitants of the Greater Accra and Eastern regions is sourced from a wide range of forest stands and savannah across the country, Berkeley Air Monitoring Group determined that it is reasonable to make a national estimate, particularly when regional information does not exist or is unreliable. Based on their understanding of the forestry sector in Ghana, Berkeley Air expects that the national assessment is more conservative than regionally-specific calculations would be.

Mean annual increment (MAI):

MAI is the annual amount of biomass regrowth within the supply area, either from natural vegetative growth or replanting. Although the MAI would ideally be calculated for the biomass used for charcoal production only or for all woodfuel (charcoal plus fuelwood) only, the growth and harvesting of woodfuel cannot be separated from the growth and harvesting of all wood for all purposes. Consequently, we focused on the MAI for all wood, not just woodfuel.

Ghana's total growing stock (S), as defined and calculated by the FAO, is 321,000,000 m^3 [19]. A widely accepted and generic value of 2.5% was used for the rate of regrowth (r)[20]. Multiplying S by r gives us the total mean annual increment (MAI):

$$MAI = S * r = 321,000,000 \, m^3 * 0.025 = 8,025,000 \, m^3$$

(b) Quantify non-renewable biomass

The annual harvest (H) of wood countrywide in 2005 was 29,458,000 m^3.[21]

[17] FAOSTAT-Forestry Database, 2005, http://faostat.fao.org

[18] http://www.fao.org/docrep/009/j8227e/j8227e06.htm#TopOfPage

[19] 2007 State of the World's Forests, FAO. Annex pg 117. Available for download at http://www.fao.org/docrep/009/a0773e/a0773e00.HTM

[20] As first estimated by Openshaw in 1982 (Openshaw, K., An Inventory of Biomass in Kenya: A Conditionally Renewable Resource. 1982, Stockholm, Sweden: Beijer Institute, (Stockholm Environmental Institute))

$$X_{nrb} = 1 - (MAI/H) = 1 - (8,025,000 /29,458,000) = 0.73 (73\%)$$

Thus, the percent non-renewability of woodfuel for Ghana is 73%, to be applied to both charcoal and fuelwood.

Sensitivity Analysis

In order to see the effect of variability or error in the parameters used to estimate the non-renewability fraction, a simple sensitivity analysis was performed. As X_{nrb} is equal to 1–(MAI/H), where MAI is equal to the total growing stock (S) times the growth rate (r), S, r, and H are the parameters of interest.

- X_{nrb} = 0.73
- A 10% increase in MAI (which is equivalent to a 10% increase in either the total growing stock [S] or the growth rate [r]) would result in an X_{nrb} of 0.70 (a 3.7% decrease)
- A 10% increase in H would result in an X_{nrb} of 0.75 (a 3.4% decrease)

Sense-check

In order to provide a sense-check of the non-renewability fraction calculated for Ghana in this report, Table 5 below illustrates a calculation of non-renewability for several countries in West Africa, using the same methodology and figures provided in 2005 by the FAO country profiles (FAOSTAT-Forestry Database, 2005, http://faostat.fao.org).

Note that established non-renewability fractions are not readily, if at all, accessible for West Africa. As the FAO notes, "[d]espite several past attempts at improving biofuel information systems in Africa, woodfuel information is still very scarce or [of] poor quality, which prevents countries from undertaking detailed diagnosis and relevant planning activities"[22].

National biomass non-renewability estimates for West Africa

Country	Growing stock (m^3) (forest + wooded land)	MAI (m^3) (growing stock * 2.5% growth rate)	Annual Wood Harvest (m^3)	X_{nrb}
Burkina Faso	248,000,000	6,200,000	7,338,000	0.16
Cameroon	1,313,000,000	32,825,000	19,772,000	-0.66 (0)
Ghana	321,000,000	8,025,000	29,458,000	0.73
Guinea	520,000,000	13,000,000	14,001,000	0.07
Guinea-Bissau	51,000,000	1,275,000	1,417,000	0.10
Liberia	498,000,000	12,450,000	5,918,000	-1.1 (0)
Mali	443,000,000	11,075,000	6,386,000	-0.73 (0)
Niger	25,000,000	625,000	12,473,000	0.95
Nigeria	1,386,000,000	34,650,000	86,627,000	0.60

[21] 2005 State of the World's Forests Report – Annex 3 pg 282
ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E14.pdf
[22] http://www.fao.org/docrep/009/j8227e/j8227e06.htm#TopOfPage

Senegal	347,000,000	8,675,000	5,110,000	-0.70 (0)
Western Sahara	38,000,000	950,000	6,332,000	0.85

* MAI calculated from total growing stock (FAO 2005) and a generic 2.5% growth rate (see Annex 6 for further explanation of default growth rate).

The table shows that NRB varies widely in West Africa. Ghana certainly has one of the higher NRB fractions in the region; although Niger and Western Sahara are higher. It is interesting to note that each of the NRB fractions exist within a particular geographic, social and economic context so that the fraction varies according to the size of existent forest, population, harvesting practices, and the country's position on the so-called energy ladder.

(c) Maintain conservativeness

The above calculation assumes that the wood-fuels consumption is the only harvest of wood in the country and that the figures we are using apply through the project period. In fact, they are changing each year in most cases are already a few years out of date. Demand for wood has been growing rapidly in previous years and will continue to grow through the project period. Urban growth is very pronounced, and demand for construction timber is rising. General population growth is 2% per year[23] , and the demand for charcoal is estimated to increase, in part, due to urbanization[24].

The equation NRB = H – MAI (non-renewable biomass = harvest – mean annual increment) must therefore be seen in terms of an increasing value of harvest (H) and a decreasing value of the mean annual increment (MAI), giving an increasing shortfall or a worsening non-renewable biomass condition. The figures quoted from recent studies reflect conditions in the past few years, and many of them need to be updated such that the non-renewable quantity at the start of the project is greater than estimated here. Equally, as the project progresses, the trends will unfortunately be toward an increased non-renewable component of wood-fuels rather than decreased. Both this project and other similar projects in Ghana will serve to mitigate this effect since projects such as this decrease biomass consumption and allow regrowth to better match harvest rates. This alone would decrease the non-renewable percentage of biomass over time. However, other pressures on biomass resources, such a simple population growth, are likely to outweigh these effects over the course of this project.

Step 1.4: Divide pilot Sales Record into customer groups or clusters

Berkeley Air Monitoring Group determined possible cluster definitions, which would be later tested in the KSs they conducted. At this stage, Berkeley Air theorized that only one, or potentially two clusters existed.

Step 1.5: Carry out a qualitative survey (KS)

The majority of TEL's current charcoal stove sales occur in the Greater Accra Region (35%) and the Eastern Region (43%). Kitchen Surveys (KSs) were therefore administered by the Berkeley Air Monitoring Group on customers within those two regions. The purpose of a Kitchen Surveys (KSs) is to define the groups, or clusters, for which future kitchen performance test (KPT) sampling will occur. 125 Kitchen Surveys were collected in total by a field team of three plus one supervisor in May 2008. The Kitchen Survey households were chosen from TEL's sales record using clustered random sampling inside of the two regions of Ghana. The sales records were used, along with input from TEL's local sales representatives, to target areas with high concentrations of sales of the stove. These areas were representative of and demographically similar to Toyola's typical Greater Accra and Eastern Region customers. The breakdown of the Kitchen Surveys by region and village is shown below:

[23] https://www.cia.gov/library/publications/the-world-factbook/print/gh.html
[24] Hagan, EB. Forecasting woodfuels demand in Ghana – the process model approach. Accessed: http://www.p2pays.org/ref/35/34359.pdf

- 75 surveys in the Eastern Region; Villages: Ayikuma, Nsawam, Koforidua, Akuapem North, Kitase, Obosomase, and Abun Kitase
- 50 surveys in the Greater Accra Region; Villages: Dangbe West, Agrama, Pokuase, Greater Accra West, and Amansama

Step 1.6: Refine demarcation of clusters and populate project database

The KS did not reveal any relevant differences in the dry and rainy seasons regarding the number of people cooked for, the number of meals cooked per day, the frequency of use of fuels other than charcoal, and the types of foods cooked. The KS did not reveal any significant differences in the Eastern Region and Greater Accra. The similarity in the number of people cooked for is shown in the figure below.

	Before Improved Stove[25] *(HHs with 1 or more uses per day)*
Fuelwood	38 of 125 (30%)
LP Gas	16 of 125 (13%)
Kerosene	2 of 125 (2%)

Overall, the KS identified one potential clustering criterion for estimating the fuel savings of efficient stove users: that of daily use or non-use of fuelwood.

2. Calculate baseline emissions

Step 2.1: Estimate expected variation and improvement in emission reductions

As Berkeley Air considered how they would design the Kitchen Performance Test (KPT), they estimated expected variation and improvement in emission reductions. They are professional statisticians who have significant experience with similar studies, and can readily estimate an appropriate approach in such cases.

Step 2.2: Specify the units of emission reduction or fuel consumption

Berkeley Air reported all of their emission saving numbers in kg per household per day, or kg/hh/day.

Step 2.3: Make quantitative measurements (KPTs)

In all cases, paired sampling for KPTs – sampling the same users before and after beginning use of a new cook stove - was performed. KPTs were performed on households with similar socioeconomic and demographic characteristics as TEL customers (as defined by the cluster definitions from the KS), but who did not have stoves prior to the test. They were then provided with a stove for purposes of the test. Any households that already owned Toyola Coalpot stoves were not included.

<u>Charcoal Savings Results</u>

The table below summarizes the charcoal use results of the 3-day KPT before and after purchase of an improved stove, in units of kilograms per household-day (kg/HH-day). The lower bound of the 90% confidence interval for charcoal savings (Before – After) are also shown, along with the p-value of a paired, two-sided t-Test for significance. Results for all 54 households and each of the two sub-groups are shown.

[25] Note that each category of users in this chart represents users that use both charcoal and the fuel in question in tandem. All users surveyed as part of the KS are charcoal users since they are Toyola customers.

Daily charcoal use results of the kitchen performance test in kilograms per household per day (kg/HH-day). The standard deviations are shown in parentheses.

Sub-group	*# of HHs*	*Charcoal Use Before Improved Stove*	*Charcoal Use After Improved Stove*	*Charcoal savings, Before–After*	*t-Test*
		(kg/HH-day)	*(kg/HH-day)*	*(kg/HH-day)*	*(p value)*
All households	54	1.5 (0.8)	1.0 (0.4)	0.50 (0.8)	0.00005
No fuelwood HHs	36	1.5 (0.7)	1.1 (0.4)	0.42 (0.7)	0.0008
Daily fuelwood HHs	18	1.4 (1.0)	0.9 (0.3)	0.54 (0.9)	0.02

As the t-Test p-values in the table above reveal, all groups had significant charcoal savings.[26]

Fuelwood Savings Results

Along with charcoal use, fuelwood use was measured in all daily fuelwood-using households. The lower bound 90% confidence interval for fuelwood savings is shown in the table below.

Daily fuelwood use results of the kitchen performance test in kg per household per day. The standard deviations are shown in parentheses.

Sub-group	*# of HHs*	*Fuelwood Use Before Improved Stove*	*Fuelwood Use After Improved Stove*	*Fuel wood savings (Before–After)*	*t-Test*
		(kg/HH-day)	*(kg/HH-day)*	*(kg/HH-day)*	*(p value)*
Daily fuelwood HHs	18	3.6 (1.8)	2.9 (1.5)	0.73 (1.6)	0.07

Fuelwood savings adjustment factors

The Kitchen Surveys revealed that about 30% of efficient stove purchasers also cooked daily with fuelwood; this percentage was generally confirmed by local knowledge of the efficient stove customers. Thus, an adjustment of 0.30 was applied:

0.73 kg/HH-day * 0.30 = 0.2 kg/HH-day (adjusted daily fuelwood savings)

Final Daily Fuel Savings

Although the other three stove models only make up a small percentage of stove sales (less than 5%), it was necessary to determine a fuel savings conversion factor that can be applied to charcoal savings. Berkeley Air estimated the relative charcoal savings potential ratios across all stove sizes based on similar adjustment factors determined for different stove emissions reduction projects in the region. That is, they assigned accurate conversation factors based on the size difference between the KPT stove and these other sizes, and other similar tests across different size stoves in the region and with similar stove designs. Prior calculations from both Uganda and Mali suggest that the adjustment factors used on the following page for charcoal offer a conservative estimate of emission reductions for the other three stove sizes. Based on these factors, fuel savings of the various sizes of stoves in TEL's product line are summarized in the table below.

Daily charcoal and fuelwood savings for each stove type

	Daily Fuel Savings (kg/HH-day)	
	Charcoal	*Fuelwood*

[26] See annex 6 for further analysis of these numbers and their significance.

Large commercial	1.4 * 0.5 = 0.7	0.2
Small commercial	1.2 * 0.5 = 0.6	0.2
Medium household (KPT stove savings at lower bound of 90% confidence interval)	0.5	0.2
Small household	0.5 * 0.5 = 0.25	0

See annex 6 for the full baseline report from Berkeley Air Monitoring Group, which explains their rationale, methodology and calculations in detail.

Step 2.4: Calculate baseline

The CEIHD Household Energy Carbon Calculator (CHECC) is a detailed excel model developed by the Center for Entrepreneurship in International Health and Development (CEIHD) that estimates emission reductions of carbon dioxide, methane and nitrous oxide from improved cookstoves. Annex 2 summarizes the input data and assumptions that were used in this model. CHECC is a new tool that will be available under license from CEIHD and is in the process of being validated for streamlined use in cookstove carbon offset programs.

3. Net leakage

The project has investigated, and will continue investigating, the following sources of leakage listed here. No significant sources of leakage were identified at this point in the project, but future offset calculations will be adjusted accordingly if significant sources are later identified:

a) *The project stimulates increased use of non-renewing biomass (for example, or by stimulating families to eat more or cook more, due to savings in charcoal use). This is sometimes referred to as the 'rebound effect.' This is accounted for in the paired KPT design, as explained below.*

b) *The project stimulates increased use of non-renewing biomass by virtue of reducing pressure on the resource (for example by lowering prices of charcoal). This is partially accounted for in the paired KPT design, as explained below.*

c) *Users of efficient stoves replace lower emissions technology than the improved stove. For example, switching from inefficient fuelwood to efficient charcoal can yield an increase in overall emissions in some cases. This is accounted for in the paired KPT design, as explained below.*

d) Improved stove users compensate for loss of the space heating effect of inefficient cook-stoves by adopting some other form of heating, such as open fires, or by retaining some use of inefficient stoves. This is accounted for in the paired KPT design, as explained below. In addition, this effect is not relevant in the context of Ghana.

e) *The traditional charcoal stoves replaced by the improved stoves are re-used by the same families or other families in a manner suggesting increased consumption of charcoal beyond the baseline demand level. This is accounted for in the paired KPT design, as explained below. In cases where replaced stoves are used by other families, they do not replace efficient stoves and therefore do not yield a net increase in emissions. Furthermore, an inefficient stove buyback system is in place, which provides incentives to surrender inefficient stoves in exchange for a discount on efficient stoves. See applicability criteria 1 in section B.1.1. for more details.*

f) *Manufacture, distribution, or use of the improved stoves gives rise to new emissions associated with transport or manufacturing. Evidence exists that this effect is more than compensated for by reduction in transport emissions due to decreases in charcoal use, as explained below.*

The quantitative results of the KPT subsumes[27] the potential sources of leakage a, c, d and e, above. Because the KPT represents fuel savings in actual households, the results already incorporate the effects of these potential leakages.

Should a decrease in price of charcoal as a result of decreased demand result in increased charcoal use (effect b above) a paired KPT will account for increased charcoal use within the project boundary, but not outside of the project boundary. Periodic assessment of NRB baseline as part of the monitoring methodology will inform whether this leakage parameter should be adjusted in the future.

Leakage from transport or manufacturing (effect f above) is also not addressed by the KPT. However, it appears to contribute to surplus emission reductions (from reduced charcoal shipments to from the supply area to the point of consumption) as much, if not more, than it contributes to leakage.

The potential sources of leakage discussed above will be followed throughout the project period.

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 VER project activity:

The project will reduce the amount of GHGs emitted through reduced use of charcoal as a cooking fuel by promoting widespread use of efficient charcoal stoves that will replace existing inefficient stoves. The project has not previously been announced for implementation without seeking carbon finance within the last 3 years.

The UNFCC Additionality Tool (Version 5.2) requires that 4 steps are taken to investigate whether or not the emission reductions would be achieved in the absence of the project activity. Taking these 4 steps in turn:

1. *Identify alternatives to the project activity that are consistent with mandatory laws and regulation.*

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

Four credible alternatives to the project activity exist. 1) First, the project activity could proceed without being registered as a Voluntary Gold Standard project. 2) Alternatively the target population could continue to cook using the same inefficient cooking technology and consume greater amounts of fuel. 3)The target population could also cook with another fuel, such as liquefied petroleum gas (LPG). 4) Finally, the target population might also cook using a solar cooker. Although solar cookers can only be used when the sun is shining and LPG produces a different taste in the food that introduce some cultural barriers, broadly speaking, these alternatives would provide a similar level of service, at least in the near term. Over the long term, continuing the business-as-usual scenario could lead to fuel shortages, thereby decreasing service levels.

[27] Kitchen Performance Tests are conducting using paired tests and measurement of real, observed reductions in charcoal usage in the field. That is, a household's charcoal use is measured for a period of three days in the absence of a SEWA stove. The family is then provided with a new SEWA stove and is not told specifically to use only the new stove. Charcoal use is then measured for a three day period with the SEWA stove. Charcoal savings is calculated by subtracting usage before the SEWA stove from usage after. Our emissions reduction projections, improved indoor air indicators and other variables that depend upon lower charcoal consumption are derived from these robust, third party measurements.

Sub-step 1b : Outline consistency with Ghanaian law

All alternatives are consistent with Ghanaian law since there is no legislation in Ghana that requires the use of efficient or renewable stoves. Moreover, none is expected to be introduced during the project period.

(proceed to step 3, "barrier analysis" since an investment analysis will not be applied)

3. *Barrier analysis*

Sub-step 3a: Identify barriers that would prevent the implementation of the proposed project activity:

- *Financial barrier*

With respect to additionality, the Gold Standard VER methodology being applied states that, "the project proponent must show that the project could not or would not take place without the presence of carbon finance. Possible reasons may be that the initial investment… (is) …not affordable to the target project population in the form of high stove prices."

Evidence gathered from end users, independent artisans, sales agents, Toyola's staff and third party research[28] suggests that at full price Toyola stoves are unaffordable to the majority of Ghanaians whose average GDP per capita (PPP) is $1,400[29]. In smaller villages, an $8 stove accounts for several percent of annual incomes. Moreover, the ability of users to save this amount of money to purchase the stove all at once is extremely limited. This means that offering microcredit is an essential ingredient to allowing sales to grow in Ghana.

As a result of E+Co's financing and E+Carbon's VER prepayment, neither of which would have been offered without the promise of future carbon revenues[30], Toyola enjoyed sufficient working capital to start a micro lending arrangement, thereby offering end users the opportunity to purchase stoves on credit over multiple instalments. This situation allowed for sales to grow significantly. Indeed, without microcredit the business would not have grown, and without investment and VER pre-payments, there would have been no microcredit. Toyola would have never been able to pay their loan back without microcredit, nor will Toyola be able to pay back loans in the future if carbon revenues are not realized.

No micro lending scheme was available for such stoves prior to Toyola offering this financial service to end users. Micro-credit organizations tend to have a strong bias towards productive vs consumptive loans. That is, they prefer to lend for purchases that will lead directly to income generating activities[31]. Although stoves that improve public health and promote sustainable development have linkages to ones income, micro-credit organizations tend not to recognize these linkages, making credit for these stoves and therefore their affordability limited among the target population. For this reason, TEL was forced to create their own lending scheme.

Toyola has offered a rebate of Ghana Cedi (GHC) 1to end users since the start of the project activity, payable upon the receipt of carbon revenues (ie, a 10% discount when stoves are sold at $10/stove or a 12.5% discount if sold at $8/stove). This rebate will allow end users to realize a partial refund on their purchase, which further helps to overcome end user financial hurdles. Once the project is approved, the rebate system will be changed to a discount

[28] Barnes, Douglas et al. *What Makes People Cook with Improved Biomass Stoves?* World Bank Technical Paper. http://ehs.sph.berkeley.edu/krsmith/publications/94_barnes_1.pdf

[29] CIA World Fact Book. Accessed July 30, 2008: https://www.cia.gov/library/publications/the-world-factbook/geos/gh.html

[30] Explained and referenced in the Investment Barriers section.

[31] Cortiglia et al. Using Microfinance to Expand Access to Energy Services: Summary of Findings, November 2007. Sustainable Energy Solutions and the Small Enterprise Education and Promotion (SEEP) Network.

on stoves upon sale that will be larger than the current rebate. With the addition of carbon finance, efficient charcoal stoves will be cheap enough for lower income households in Ghana to afford them. That is, some carbon revenues will act as a direct subsidy so that efficient stoves are cheaper than their business-as-usual counterparts.

Raw materials cost has increased dramatically in Ghana[32], further exacerbating the affordability issue. Among other reasons, the Chinese have been buying raw materials as their economy expands[33], demanding ever more natural resources at home and increasing prices in places like West Africa. Everything from scrap metal to nails to cement has increased significantly[34], a cost that will have to be passed onto the consumer in the absence of carbon revenues.

- *Investment barrier*

As highlighted in the UNFCCC additionality tool, credible investment barriers include evidence that "no private capital is available from domestic or international capital markets due to real or perceived risks associated with investment in the country where the proposed CDM project activity is to be implemented."

With a credit rating of 37.6 out of 100[35], Ghana is an exceedingly difficult country in which to gain investment capital for a new business[36]. A 2007 World Bank study concluded that more than 66% of Ghanaian firms identify access to finance as a major constraint. The same study states that only 16% of firms are using banks to finance investments[37]. In the rare event that entrepreneurs are approved for loans, interest rates for small business loans are exorbitantly high and unaffordable for all but the most profitable industries. Ghana's prime lending rate is currently set at 17%[38] and has been in this vicinity since Toyola's inception. The average bank base rate among 25 Ghanaian banks, however, is 27%[39], which is a better proxy for small business lending for lenders with excellent credit ratings and large quantities of collateral. Experts suggest that a company like TEL, in its financial state in 2006, would have faced interest rates closer to 32%[40].

It is critical to recognize that E+Co is not a typical lender, and specifically lends to businesses in the developing world that are unable to seek traditional forms of financing. E+Co and E+Carbon offered financing in the form of two, low interest loans, as well as a prepayment on VERs respectively. All of this investment took place based upon the premise that Toyola would be able to realize carbon revenues from its activities[41]. If carbon revenues were not a

[32] Broadman, Harry G. Africa's Silk Road: China and India's New Economic Frontier. The World Bank, 2007. http://siteresources.worldbank.org/INTAFRICA/Resources/asr_complete_rpt.pdf , pg 196.

[33] China Winning Resources and Loyalties of Africa, Financial Times, February 28, 2006. http://yaleglobal.yale.edu/display.article?id=7051

[34] Wahab O, Suraj, Personal interview. December, 2008.

[35] Institutional Investor Magazine. Accessed December, 2008. http://www.iimagazinerankings.com/countrycredit/RegionsRpt.asp?PageID=RegionsRpt&Type=1

[36] Broadman, Harry G. Africa's Silk Road: China and India's New Economic Frontier. The World Bank, 2007. http://siteresources.worldbank.org/INTAFRICA/Resources/asr_complete_rpt.pdf, pg 196.

[37] World Bank's Enterprise Surveys. Accessed December, 2008. http://www.enterprisesurveys.org/ExploreEconomies/?economyid=76&year=2007

[38] Bank of Ghana website, accessed December, 2008. http://www.bog.gov.gh/

[39] Business Ghana, http://www.businessghana.com/portal/finance/index.php?op=getBankRates&date_id=, accessed December, 2008.

[40] Yankey, Vincent. E+Co Investment Officer for Ghana. Personal interview, 18 December, 2008.

[41] E+Co investment summaries and records of VER pre-payments, which were provided confidentially to validating DOE.

realistic future capital stream, E+Co and E+Carbon would not have offered this capital. Without this financing, Toyola would not have had sufficient working capital to grow their business to its current scale, as outlined in other barriers in this analysis. That is, existing sales levels are based entirely on the fact that E+Co and E+Carbon invested in TEL when TEL had no where else to go for financing. Sales prior to E+Co's investment in 2006 were insignificant, on the order of 1,000 stoves per year[42].

When evaluating baseline determination, it is important to consider that new sales at TEL consist of replacing inefficient stoves, not replacing efficient stoves, in spite of there having been sales in the past. As such, the baseline scenario is the use of inefficient stoves and historical sales, however insignificant, should not be considered.

- *Knowledge barrier*

The methodology being applied also states that, "…possible reasons (that the project might not take place in the absence of carbon finance) may be that on-going costs for … marketing and distribution … are not affordable…"

Indeed, a key obstacle to the project activity taking place in the absence of carbon revenues is a lack of awareness among potential users regarding the benefits associated with Toyola Coalpoat stove use. Toyola has an extremely capital intensive sales approach that involves going door to door and village to village, raising awareness of the health and economic benefits of improved stoves. In fact, cooking practices are deeply entrenched in culture, and therefore changing them requires aggressive, community-based and resource intensive marketing techniques. This approach would not be taking place and will not take place in the future in the absence of E+Co's financing and the carbon revenues on which E+Co's financing depend.

- *Prevailing practice.*

Habitual use of traditional stoves imposes a very strong influence on the baseline scenario, resulting in continued use of traditional inefficient charcoal stoves. Fuelwood and charcoal meet approximately 75% of Ghana's fuel requirements[43]. Approximately 69% of all urban households in Ghana use charcoal[44]. Only a small minority of these households are cooking on improved stoves.

Sub-step 3b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

Financial barrier: Financial barriers will not prevent the business-as-usual alternative of continuing to use inefficient cooking technologies from occurring. Cooking on three-stone fires and other ad hoc technologies is virtually free, while inefficient stoves are less expensive than their efficient counterparts, offering fewer financial hurdles. In Ghana, a traditional coalpot stove - the stove most widely used in urban areas - cost about $1.50 - $2.20[45] compared to $8-10 for the average sized Toyola Coalpot stove.[46] Alternatives 3 and 4, cooking with LPG and solar cookers respectively, are eliminated at this stage since they face considerably larger financial barriers than the project activity. Solar cookers can cost from $30 to over $100 depending on their design. LPG burners and cylinder cost on the order of $30, while LPG fuel is significantly more expensive than charcoal and fuelwood. Although these are clean and beneficial technological alternatives, they are probative expensive for most Ghanaians.

[42] Records during this period are scarce as TEL was operating in the informal sector and did not have proper accounting and record keeping procedures.
[43] http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=GHA&subj=5
[44] FASO Ghana report

[45] Stosch, Lisa and Wilhemina Quaye*, A Study of Fuel Consumption in Three Types of Household Charcoal Stoves in Ghana*. Accra, Ghana. December, 2002

[46]E+Carbon and DOE field observations in Accra and elsewhere. December, 2008.

Investment barrier: The investment barriers identified will not prevent the business-as-usual alternative of continuing to use inefficient cooking technologies. Ad hoc technologies such as three stone fires do not require any manufacturing and therefore do not require financing. Inefficient stoves can be manufactured using less expensive and more common practices. Since the target population can afford less expensive inefficient stoves, it is possible to create a profitable business in spite of lacking access to working capital, since micro-lending and capital intensive marketing are not central inputs to the inefficient stove industry. When reinvested, these profits lead to excess working capital to grow a company, thereby alleviating investment barriers.

Moreover, inefficient stoves can more easily be manufactured in cottage industries and informal economies where traditional investment is not an essential ingredient to success. Manufacturing inefficient stoves requires little equipment and facilities that require financing. Efficient stoves, on the other hand, require capital intensive kilns and other equipment for which formal investment is required. The prevalence of inefficient stoves among the target population supports the assertion that manufacturing and selling such stoves is a profitable venture.

Knowledge barrier: Knowledge barriers do not plague inefficient cooking technologies in the same way due to their prevalence. The target population is aware of and accustomed to this technology, and do not require special training or targeted marketing prior to purchasing or using this technology. Knowledge of inefficient stoves is deeply entrenched in Ghanaian culture.

Prevailing practice: As explained in previous sections, inefficient stoves are present in most Ghanaian kitchens and are deeply entrenched in Ghanaian culture. They define the prevailing practice and are therefore not deterred by this barrier.

4. *Common practice analysis.*

Sub-step 4a: Analyze other activities similar to the proposed project activity:

Only one other case of large scale efficient stove dissemination exists in Ghana. EnterpriseWorks, with their international partner ClimateCare JP Morgan Chase, are developing a project of similar geography and technology (although distinction can be made between the stoves in the field). This project, however, is seeking carbon revenues to reach scale, underscoring that fact that carbon revenues are an essential ingredient to the success of improved stove projects in Ghana.

Although other improved stove dissemination efforts have been performed in Ghana, none other are of similar scale and ambition, nor are they subsidy free, market-based efforts. For example, the Ahibenso was promoted by the Ghana Solar Energy Society and funded by the United Nations Development Programme. While this program started as far back as 1992, it never reached significant scale or financial sustainability[47]. The GYAPA effort started as a grant-based program led by Enterprise Works and funded by the Shell Foundation and USAID, but now that they are structuring a carbon finance project around the work, it is growing far more quickly and is more financially sustainable than before.

In addition to the Ghanaian example of carbon finance and stoves, it is instructive to highlight examples in other African nations in similar circumstances. To identify additional examples, we take a nation's per capital gross domestic product (GDP) as a proxy for end users' ability to afford efficient stove technology and a nation's credit rating as a company's ability to gain access to market sources of finance other than carbon finance. We then compare these variables with how efficient stove efforts are being funded in those nations.

[47] Stosch, Lisa and Wilhemina Quaye, *A Study of Fuel Consumption in Three Types of Household Charcoal Stoves in Ghana*. Accra, Ghana. December, 2002

Nigeria – With a per capita GDP (PPP) of 2,100[48], Nigerians should find improved stove technology more affordable than Ghanaians. Moreover, Nigeria's credit rating is 40 out of 100[49], suggesting slightly fewer barriers to borrow in that nation compared with Ghana. Yet an efficient stove project is currently under consideration for CDM funding in Nigeria[50].

Mali – With a per capita GDP of $1,000[51], Malians' purchasing power is similar to that of Ghanaians'. Their credit rating is 24.1 out of 100[52], and business loans are very difficult to attain, especially for such ventures as efficient stove manufacturing. The only market-based, large-scale stove dissemination effort in Mali is currently seeking approval for carbon revenues[53].

Uganda – Uganda's per capital GDP of $1,000[54] also suggests that efficient stoves pose a similar burden on household budgets. With a credit rating of 29.9 out of 100[55], financing for such business is equally unattainable. Uganda is host to at least one efficient stove project funded entirely through carbon finance[56].

As is clear from these examples, carbon finance is quickly becoming the primary mechanism with which to fund improved stove technologies in countries with similar economic circumstances to Ghana. These examples provide an additional credibility check to the additionality rationale outlined in steps 1-3 above.

Sub-step 4b: Discuss any similar options that are occurring:

All similar options discussed necessitate access to carbon finance, and thus do not contradict the claim that the proposed project activity is subject to the barriers outlined in step 3.

[48] CIA World Factbook, https://www.cia.gov/library/publications/the-world-factbook/geos/ni.html Accessed December, 2008.

[49] Insitutional Investor Magazine. Accessed December, 2008. http://www.iimagazinerankings.com/countrycredit/RegionsRpt.asp?PageID=RegionsRpt&Type=1

[50] PDD: *Efficient Fuel Wood Stoves for Nigeria,* October, 2008.

[51] CIA World Fact Book. Accessed December, 2008: https://www.cia.gov/library/publications/the-world-factbook/geos/ml.html

[52] Institutional Investor Magazine. Accessed December, 2008. http://www.iimagazinerankings.com/countrycredit/RegionsRptP3.asp

[53] Voluntary Gold Standard APX Registry.

[54] CIA World Fact Book. Accessed December, 2008: https://www.cia.gov/library/publications/the-world-factbook/geos/ug.html

[55] Institutional Investor Magazine. Accessed December, 2008. http://www.iimagazinerankings.com/countrycredit/RegionsRptP2.asp

[56] Voluntary Gold Standard APX Registry.

Greenhouse gases to be included in the project:

	Source	Gas	Included?	Justification / Explanation
Baseline	Cooking, production of fuel, and transport of fuel	CO_2	Yes	Important source of emissions
		CH_4	Yes	Important source of emissions
		N_2O	Yes	Important source of emissions

	Source	Gas	Included?	Justification / Explanation
Project	Cooking, production of fuel, and transport of fuel	CO_2	Yes	Important source of emissions
		CH_4	Yes	Important source of emissions
		N_2O	Yes	Important source of emissions

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

The project boundary here is defined as the domestic or institutional kitchens of the project population using Toyola Coalpot stoves. The target area, as defined in the methodology being applied here, is Toyola's current distribution network throughout the Greater Accra Region, Eastern Region, Ashanti Region and Central Region, but will gradually expand to cover major towns and market centers in all regions of Ghana, including Western, Brong-Ahafo, Volta, Upper West, Upper East and Northern. This forms the outer limits of the project boundary. New baseline assessments will accurately account for the target area as it expands, as outlined in the monitoring section. The methodology also requires that the fuel collection area be clearly delineated. For a full description of the fuel collection area and the approach for its delineation, see the baseline study in annex 6. Note that since the non-renewable biomass baseline is monitored over time and can vary, the fuel collection area can also change as fuel collection habits change in Ghana and as Toyola's target area expands.

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:

Berkeley Air Monitoring Group has completed a full baseline and non-renewability assessment of TEL and its market in June, 2008. The full report can be found in annex 6.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

14/11/2006 *(the date of disbursement of a debt investment from E+Co to Toyola for $70,000)*

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

30 years

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

The crediting period is fixed.

C.2.1. Renewable crediting period NA

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

C.2.1.2. Length of the first crediting period: NA

C.2.2. Fixed crediting period:

10 years

C.2.2.1. Starting date:

31/08/2007

C.2.2.2. Length:

10 years, 0 months.

SECTION D. Application of a monitoring methodology and plan

Monitoring will be conducted according to the prescribed approach in the methodology and as detailed below.

A. The monitoring tasks are:

1. Maintenance of a Total Sales Record.

E+Carbon assists the project implementing body Toyola to maintain and make available accurate records. E+Carbon collates a composite electronic Total Sales record and Toyola keeps backup paper records. Toyola's existing accounting and records system accurately tracks sales, inventories and supply and purchases. Toyola maintains a full sales database in Excel of all sales that take place, listed according to the sales mechanism, date and stove type. Sales databases are cross checked with production records and other data to ensure consistency and accuracy.

The Total Sales Record is comprised the following data:

- Date of Sale
- Mode of use: Resale, direct residential use, direct institutional use (sold via which sales depot)
- Model/type of stoves purchased
- Number of stoves purchased

2. Maintenance of a Detailed Customer Record

Detailed Customer records include the following data:

- Date of sale
- Mode of use: resale, direct residential use, direct institutional use
- Model/type of stoves purchased
- Number of stoves purchased
- Name and telephone number
  - All bulk purchasers (local agents and stove retailers) and institutional users
  - End users: all that complete a rebate card (although not required by the methodology being applied, the aim will be to collect this or an address from nearly all users)
- Address: as many as possible

The sales information will be collected using the following methods:

The project proponent and owner have implemented a system of rebate cards to be completed by end users upon sale[57]. If this project is approved, the rebate will be converted into a discount at point of sale. End user information cards will still be completed upon sale once the rebate is discontinued. Rebates are currently used as a mechanism to avoid risking additional capital above what has already been invested if the project is not approved for carbon finance. These cards include personal contact details of end users, which are collated into an electronic database from which project monitoring can be conducted. The excel records are backed up and sent to the project coordinator for checking prior to using them as the basis for

[57] These cards serve three functions: they collect end user contact information to facilitate monitoring, offer a rebate, which helps to prove additionality, and they offer end users the opportunity to "sell" their ownership rights to emissions reductions in the form of a discount from a rebate.

quarterly monitoring activities. Hard copies of rebate cards are filed as additional backup and for verification purposes.

For all direct sales to end-users TEL will collect this information personally. For retail and agent sales, cards are distributed with stoves and collected when the next stock of stoves is delivered. Quality assurance measures will be implemented by an external third party to check the validity of sales cards and customer information, as discussed in Section D.3, below. The customers in the sales record for which phone numbers or addresses are available will be used for survey sampling to support the periodic monitoring activities described below.

The detailed customer database consisted of about 5000 users in late 2007, but is growing constantly since most sales are entered into this database (albeit with some lag time). Although not required by the methodology, nearly all sales are entered because data is attained through a rebate card that is central to the additionality rationale and other projects in Ghana pose a risk for double counting. This helps to ensure that TEL is absolutely sure that all stoves counted in the project are in fact TEL stoves.

The detailed customer database is shared with and checked by Berkeley Air Monitoring Group, who use this as the basis for their quarterly surveys.

3. Continuous updating of the Project Database

The project database will be derived from the total sales record, dividing the purchasers into the clusters defined by the most recent Kitchen Survey (KS) results, and excluding:

- any sales that do not fall into the cluster categories (i.e. mixed fuel users, customer switching from wood to charcoal);
- any sales deemed to be erroneous records; and/or
- stoves within each cluster present on the sales record but no longer in use.

4. Calculation of emission reductions

Emission reductions are calculated using the results of the KPTs following the methodology. Stove usage will be calculated from the project database by counting days of usage since sales date, and then modifying the result by application of aging and usage factors derived from the stove-age KPT and usage survey respectively. 30 random kitchen surveys that are representative of TELs sales distribution will be conducted quarterly. Emission reduction calculations will also take into account any findings of the monitoring process with respect to NRB fraction and net leakage. Net leakage will be monitored on an ongoing basis by incorporating relevant questions into kitchen surveys.

The formulae that will be used in project progress reports are as prescribed for the baseline study in the methodology, with the difference that the time period will be quarters rather than years, and the usage factor and aging factor are added, thus:

$$ER_q = \sum BE_{i,q} - \sum PE_{i,q} - \sum LE_{i,q}$$

Where:

ER_q = Emission reduction in total project population in quarter q (tCO_2e/qr)
$BE_{i,q}$ = Baseline emissions of cluster i in quarter q (tCO_2e/qr)
$PE_{i,q}$ = Project emissions of cluster i in quarter q (tCO_2e/qr)
$LE_{i,q}$ = Net Leakage of cluster i in quarter q (tCO_2e/qr)

Within each cluster the emissions are calculated thus:

$BE_{i,q} = N_{i,q} \cdot PE_q \cdot$ Usage Factor . Age Factor
$PE_{i,q} = N_{i,q} \cdot BE_q \cdot$ Usage Factor . Age Factor

Where PE_q and BE_q are calculated as set out in the appropriate section, and

$N_{i,q}$ = the number of Units in cluster i

B. The planned periodic monitoring tasks are:

1. The renewability status of wood-fuel used by each cluster (NRB fraction) will be re-assessed bi-annually.

2. Net Leakage factors identified in the PDD will be surveyed, while new leakage and surplus effects will be investigated bi-annually. These survey questions will be included in the KS.

3. A usage survey will be undertaken bi-annually for sales made in the first year of the project to establish the fraction of end-users who are no longer using the stove purchased from TEL over time. The sample size will be as defined for the KS. The approach will be to randomly sample users who purchased stoves in the first year of the project.

4. A "Stove-age KPT" will be undertaken bi-annually for sales made in the first year for each cluster, to measure emission reduction performance in successive years of stoves of Age x months, Age y months, and so on. A linear extrapolation is applied to all stoves of intermediate age and extended age, when calculating overall project GHG reductions.

5. A monitoring KS[58] for sales made in the previous two years will take place on a quarterly basis. 30 customers will be randomly surveyed from the detailed customer database every quarter according to the geographic breakdown of TEL's sales. The purpose is, as defined in the methodology, to make observations in kitchens to check that the cluster definitions are appropriate for statistically significant KPTs.

   Additional survey questions in the KS will inform leakage considerations.

6. If the monitoring KS reveals that baseline parameters of the type measured by KPTs may have changed significantly, or if the KS is not adequate to update evolving baseline conditions and no New-Stove KPT is taking place to perform this function, then a Monitoring KPT will be carried out not less frequently than bi-annually among new customers to update baseline parameters.

7. A "New-Stove KT" to measure fuel consumption will take place for new models and designs when they are launched, and will be repeated at least once every two years. This KPT may also be used to measure evolving baseline parameters among new customers to act as the Monitoring KPT.

8. In addition, the wider social and economic impact of the project will be investigated bi-annually to determine sustainable development impacts.

[58] Monitoring KS's are distinct from Baseline KS's in that they do not address the baseline scenario.

9. As an effort to avoid double counting, the Detailed Customer Record and Total Sales Record will be cross checked on an annual basis with any other stove projects in Ghana that sell similar enough stoves to be confused in the field.

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

Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes, Version 1

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

The methodology is specifically designed to match the project conditions.

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:

All data will be archived for a period of at least two years after the end of the project crediting period. Rebate and end user information cards are kept in hard copy, while backed up excel spreadsheets of the Total Sales Record and Detailed Sales Record are kept with TEL and copies with the project proponent. All KS and KPT records and data are kept with Berkeley Air Monitoring Group. The table below attempts to simplify the variables from the methodology into what data is actually collected in the field and relate that data to the variables outlined in the methodology. This is useful since many of the variables outlined in the methodology are several steps removed from the data actually collected in the field. A full list of monitored variables according to the methodology is available in annex 3.

ID #	*Data variable (relation to variables from methodology)*	*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*
1	*Non-Renewable Biomass fraction (Xnrb,bl,y & Xnrb,pj,y from methodology)*	*FAO, FOSA, Rural KS surveys*	*Xnrb: % non-renewable biomass*	*M, C, E*	*Biannually*	*Sufficient depth and conservative approach*	*National Data are electronic. Survey results are paper and electronic*	*Following approach of baseline assessment*
2	*Stove Sales (input to variables* Bbl,y, Bpj,y from methodology)	*Sales Records*	*Stoves by type*	*M*	*Daily*	*All sales*	*Electronic and paper*	
3	*Eligibility of Project*	*Monitoring KS*	*As specified*	*E*	*Quarterly*	*As defined in*	*Quarterly monitoring*	

	database for KPT sampling (input to Bbl,y, Bpj,y from methodology)		*above*			*methodology*	*reports*	
4	*Emission savings in new clusters*[59] *(input to* Bbl,y, Bpj,y from methodology)	*Monitoring KPT*	*Tonnes of fuel/yr*	*M*	*Biannually*	*Statistically Significant and Representative Sample*	*Reports*	
5	*Leakage (directly from methodology)*	*Monitoring KS*	*% of total emissions*	*E*	*Biannually*	*As defined in methodology*	*Annual monitoring reports*	
6	*Usage drop-off in year y (directly from methodology)*	*Usage Survey*	*Fraction*	*E*	*Biannually*	*Statistically Significant and Representative Sample*	*Electronic*	
7	*Age - fuel savings per stove due to aging (directly from methodology)*	*Stove-age KPT*	*Fraction*	*M*	*Biannually*	*As defined in methodology*	*Electronic and paper*	
8	*New Stove (directly from methodology)*	*New Stove KPT*	*Fraction*	*M*	*Biannually*	*As defined in methodology*	*Electronic and paper*	

D.2.1.2. Data to be collected in order to monitor project performance on the most sensitive sustainable development indicators:

Sustainable Development Indicator	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)
Air Quality	*Self-reported IAP reduction, and/or ambient CO &PM concentrations*	*Reduced indoor air pollution (IAP)*	*Ambient IAP concentration*	*M, E*
Livelihood of the Poor	*Survey results*	*Household fuel cost savings*	*$ saved/year*	*M, C*

[59] Results from monitoring KPT combined with stove sales (ID#2) will determine the values for variables Xre,bl.y, Xre,pj,y, Bbl,y and Bpj,y from methodology.

Employment	*New employment*	*Job creation*	*Jobs/Year*	*M, E*
Employment quality	*Periodic assessment of conditions (age of employees, ear plugs used during metal working, etc)*	*Employment quality*	*Qualitative assessment*	*E*
Access to energy services	*Extrapolated based on total sales and average household size*	*Improved energy access*	*People/year*	*C*
Other pollutants	*Periodic assessment of conditions*	*Proper disposal*	*Qualitative assessment*	*E*

D.2.1.3. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)

The formulae used are:

$$ER_q = \sum BE_{i,q} - \sum PE_{i,q} - \sum LE_{i,q}$$

Where:

ER_q = Emission reduction in total project population in quarter q (tCO_2e/qr)
$BE_{i,q}$ = Baseline emissions of cluster i in quarter q (tCO_2e/qr) taking NRB fraction into account
$PE_{i,q}$ = Project emissions of cluster i in quarter q (tCO_2e/qr) taking NRB fraction into account
$LE_{i,q}$ = Net Leakage of cluster i in quarter q (tCO_2e/qr)

Within each cluster the emissions are calculated thus:

$$BE_{i,q} = \sum (F_{bio,fuel,yr} * (\%NR_{bio,fuel,yr} * EF_{bio,fuel,CO2} + EF_{bio,fuel,non\text{-}CO2}) * D_{bio,fuel,yr}) + \sum (F_{fuel,yr} * \%NR_{fuel,yr} * (EF_{fuel,CO2} + EF_{fuel,non\text{-}CO2}) * D_{fuel,yr})$$

$$PE_{i,q} = \sum (F_{bio,fuel,yr} * (\%NR_{bio,fuel,yr} * EF_{bio,fuel,CO2} + EF_{bio,fuel,non\text{-}CO2}) * D_{bio,fuel,yr} * (1 - U_{bio,fuel,yr}))$$

$$+ \sum (F_{fuel,yr} * \%NR_{fuel,yr} * (EF_{fuel,CO2} + EF_{fuel,non\text{-}CO2}) * D_{fuel,yr} * (1 - U_{bio,fuel,yr}))$$

Biomass Fuels

$F_{bio,fuel,yr}$: Daily fuel savings (tonnes/day) for a given biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

$\%NR_{bio,fuel,yr}$: Fractional non-renewability of biomass baseline for a given biomass fuel in a given year.

$EF_{bio,fuel,CO2}$: CO2 Emissions Factor (tCO2/t_fuel) for a given biomass fuel[60].

$EF_{bio,fuel,non\text{-}CO2}$: Non-CO2 Emissions Factor (tCO2e/t_fuel) for a given biomass fuel[61]; includes all non-CO2 gases accounted.

$D_{bio,fuel,yr}$: Days (days) of fuel savings accounted for a given biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

$U_{bio,fuel,yr}$: Annual fractional *drop-off* in the usage of the project cluster's improved cooking device or regime in a given year of usage (year 1, year 2, etc.).

Non-Biomass Fuels

$F_{fuel,yr}$: Daily fuel savings (tonnes/day) for a given non-biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

$\%NR_{fuel,yr}$: Fractional non-renewability for a given non-biomass fuel in a given year. For fossil fuels the value will be 1, for renewables, 0.

[60] For a fuel such as charcoal this EF includes CO2 emissions from production and consumption.

[61] For a fuel such as charcoal this EF includes CO2 emissions from production and consumption.

$EF_{fuel,CO2}$: CO2 Emissions Factor (tCO2/t_fuel) for a given non-biomass fuel. This can include production and consumption.

$EF_{fuel,non-CO2}$: Non-CO2 Emissions Factor (tCO2e/t_fuel) for a given non-biomass fuel; includes all non-CO2 gases accounted. This can include production and consumption.

$D_{fuel,yr}$: Days (days) of fuel savings accounted for a given non-biomass fuel in a given year of usage (baseline, year 1, year 2, etc.) of the project cluster's improved cooking device or regime.

$U_{fuel,yr}$: Annual fractional *drop-off* in the usage of the project cluster's improved cooking device or regime in a given year of usage (year 1, year 2, etc.).

D.2.1.4. 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 #	*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	*Eligibility of Project database for KPT sampling*	*Baseline KS*	*As specified above*	*E*	*Quarterly*	*As defined in methodology*	*Quarterly monitoring reports*	
Not included in D.2.1.1.	*Traditional Stove Fuel Consumption*	*Baseline KPT*	*Tonnes of fuel/yr*	*M*	*Biannually*	*As defined in methodology*	*Electronic and paper*	

D.2.1.5. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO2 equ.)
See Section D.2.1.3.

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

Option 1 chosen due to evolving baseline scenario. See section D.2.1.

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

Option 1 chosen. See section D.2.1.1.

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

Option 1 chosen. See section D.2.1.3.

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
1	*Fuel-Switching*	*Monitoring KS*	*Fraction of HHs switching fuels*	*E*	*Biannually*	*Statistically Significant and Representative Sample*	*Paper and electronic*	
2	*Further defined Net Leakage factors*	*Monitoring KS*	*Emission reduction adjustment factor*	*E*	*Biannually*	*Sufficient depth and conservative approach*	*Biannual monitoring reports*	
3	*Undefined Net Leakage factors*	*Monitoring KS*	*Emission reduction adjustment factor*	*E*	*Biannually*	*Sufficient depth and conservative approach*	*Biannual monitoring reports*	

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

The application of the leakage methodology is discussed in section B.2 above.

The monitoring procedure requires that leakage is re-investigated periodically and any findings taken into account. The governing formulae are:

LE_y = Leakage in year y – Surplus in year y

where
LE_y = net leakage in year y (in tonnes CO2e per year) specific to cluster

$ER_y = \sum BE_{i,y} - \sum PE_{i,y} - \sum LE_{i,y}$

Where:
ER_y = Emission reduction in total project population in year y (tCO_2e/yr)
$BE_{i,y}$ = Baseline emissions of cluster i in year y (tCO_2e/yr)
$PE_{i,y}$ = Project emissions of cluster i in year y (tCO_2e/yr)
$LE_{i,y}$ = Net Leakage of cluster i in year y (tCO_2e/yr)

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.)

The formulae applied for the Baseline Study utilize “Approach 1” as defined in the Methodology:

a) Baseline emissions:

$BE_y = X_{nrb} \cdot B_{bl,y} \cdot EF_{bio,CO2} + \sum(AF_{bl,i,y} \cdot EF_{af,CO2,i})$
$+ \sum(\text{Non-CO2 emissions during cooking})$
$+ \sum(\text{GHG emissions during production of the fuels})$

Where

BE_y = baseline emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

X_{nrb} = the non-renewable component of the woody biomass harvested in the project collection area

$B_{bl,y}$ = the mass of woody biomass consumed during cooking in the baseline each year (in tonnes/year).

$EF_{bio,co2}$ = the CO2 emission factor for use of the biomass fuel in tonnes CO2 per tonne fuel

$AF_{bl,i,y}$ = The mass of alternative fuel i in the baseline in year y in accordance with trends projected throughout the project period, in tonnes

$EF_{af,co2,i}$ = The CO2 emission factor for use of the alternative fuel i in the baseline in tonnes of CO2 per tonne fuel

Non-CO2 emissions during cooking = $\sum (B_{bl,y} \cdot EF_{bio,non\text{-}co2,i}) + \sum(AF_{bl,i,y} \cdot EF_{af,i,non\text{-}co2\ gas\ i})$

GHG emissions during production of the fuels = $X_{nrb} \cdot B_{bl,y} \cdot EF_{bio,prod,co2}$
$+ \sum(AF_{bl,i,y} \cdot EF_{af,prod,co2,i})$
$+ \sum (B_{bl,y} \cdot EF_{bio,prod,non\text{-}co2\ gas\ i})$
$+ \sum(AF_{bl,i,y} \cdot EF_{af,i,prod,non\text{-}co2\ gas\ i})$

Where
$EF_{bio,non\text{-}co2,i}$ = Emission factor for GHG gas i in tonnes gas / tonnes wood-fuel
$EF_{af,i,non\text{-}co2\ gas\ i}$ = Non-CO2 Emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas / tonnes fuel
$EF_{bio,prod,co2}$ = CO2 Emission factor for wood-fuel during production in tonnes gas / tonnes fuel
$EF_{af,prod,co2,i}$ = CO2 Emission factor for fuel i during production in tonnes gas / tonnes fuel
$EF_{bio,prod,non\text{-}co2\ gas\ I}$ = Non-CO2 Emission factor for wood-fuel during production in tonnes gas / tonnes fuel
$EF_{af,i,prod,non\text{-}co2\ gas\ I}$ = Non-CO2 Emission factor alternative fuel i for GHG gas i during production in tonnes gas / tonnes fuel
Project emissions:

Approach 1:

$PE_y = X_{nrb} \cdot B_{pj,y} \cdot EF_{bio,CO2} + \sum(AF_{pj,i,y} \cdot EF_{af,CO2,i})$
$+ \sum(\text{Non-CO2 emissions during cooking})$
$+ \sum(\text{GHG emissions during production of the fuels})$

Where

PE_y = project emissions in year y (in tonnes CO2e per year) specific to cluster and Unit chosen

$B_{pj,y}$ = the mass of woody biomass consumed during cooking in the project each year (in tonnes/year).

$AF_{pj,i,y}$ = The mass of alternative fuel i in the project in year y in accordance with trends projected throughout the project period, in tonnes

Non-CO2 emissions during cooking = $\sum (B_{pj,y} . EF_{bio,non\text{-}co2,i}) + \sum(AF_{pj,i,y} . EF_{af,i,non\text{-}co2\ gas\ i})$

GHG emissions during production of the fuels = $X_{nrb} . B_{pj,y} . EF_{bio,prod,co2}$
$+ \sum(AF_{pj,i,y} . EF_{af,prod,co2,i})$
$+ \sum (B_{pj,y} . EF_{bio,prod,non\text{-}co2\ gas\ i})$
$+ \sum(AF_{pj,i,y} . EF_{af,i,prod,non\text{-}co2\ gas\ i})$

$EF_{af,pj,i(ebasis)}$ = The CO2 emission factor for use of the alternative fuel i in the project in tonnes of CO2 per GJ fuel

D.3. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored

Regular monitoring is performed by E+Co monitoring and evaluation staff and Berkeley Air Monitoring Group.

Data *(All from Table 2.1.1)*	Data Variable	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
1	*Non-Renewable Biomass fraction (Xnrb,bl,y & Xnrb,pj,y from methodology)*	*Low*	*Conducted by third party.*
2	*Stove Sales*	*Low*	*Sales records will be cross-checked by 3rd party reviewer with Toyola financial accounts, production records, retailers' records, observations of retailer activity and observations made during monitoring surveys and tests.*
3	*Eligibility of Project database for KPT sampling (KS)*	*Low*	*Conducted by third party*
4	*Emission savings in new clusters (Monitoring KPT)*	*Low*	*Conducted by third party*
5	*Leakage*	*Low*	*Conducted by third party*
6	*Usage drop-off in year y*	*Low*	*Conducted by third party*
7	*Age - fuel savings per stove due to aging*	*Low*	*Conducted by third party*
8	*New Stove*	*Low*	*Conducted by third party*

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

E+Co employs Monitoring & Evaluation staff that track non-carbon sustainability indicators such as employment and environmental impacts. Carbon related monitoring tasks, such as quarterly KSs, assessment of leakage and other such tasks are handled by a third party, the Berkeley Air Monitoring

Group. Berkeley Air Monitoring Group instructs a local surveyor, paid by E+Carbon, to conduct these surveys. Survey results are delivered both electronically and via DHL in hard copy directly to Berkeley Air, who analyze the data and compile quarterly and annual reports. E+Carbon contracts Berkeley Air to undergo additional monitoring tasks, such as creating new clusters and performing additional KPTs for these clusters, based on their third party recommendations. Berkeley Air Monitoring Group also performs biannual monitoring tasks according to the methodology. The integrity of data is constantly cross checked with other variables to ensure consistency and avoid mistakes.

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

The monitoring methodology has been determined by application of the generic methodology "Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes, Version 1", developed for a range of improved stove programs. The methodology is being implemented by E+Carbon and Berkeley Air Monitoring Group.

SECTION E. Estimation of GHG emissions by sources

The equations used in calculating baseline emissions, project emissions, and emission reductions are as outlined in the Methodology and in section D.2.4 of this PDD.

E.1. Estimate of GHG emissions by sources:

Project Emissions (tCO2e)											
Carbon Flows		Project Year									
Offset Vintage	Stoves disseminated	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2007	18,000	19,988	36,886	29,410	21,000	12,590	5,243	1,039	0	0	0
2008	19,800	0	22,108	40,454	32,352	23,100	13,874	5,742	1,143	0	0
2009	21,780	0	0	24,319	44,499	35,587	25,466	15,206	6,316	1,257	0
2010	23,958	0	0	0	26,751	48,949	39,238	27,920	16,726	6,947	1,383
2011	26,354	0	0	0	0	29,426	53,979	43,026	30,712	18,399	7,651
2012	28,989	0	0	0	0	0	32,545	59,200	47,329	33,784	20,276
2013	31,888	0	0	0	0	0	0	35,800	65,120	52,062	37,244
2014	35,077	0	0	0	0	0	0	0	39,380	71,632	57,403
2015	38,585	0	0	0	0	0	0	0	0	43,318	78,994
2016	42,443	0	0	0	0	0	0	0	0	0	47,908
Total Annual Carbon Volumes (tCO2e)		19,988	58,994	94,183	124,601	149,651	170,345	187,933	206,726	227,398	250,858
								5-year total =		447,418	tCO2e
								10-year total =		1,490,677	tCO2e

E.2. Estimated leakage:

Leakage is estimated to be 0[62], as is explained in section B.2.

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

Same as E.1 as leakage is estimated to be 0.

[62] The leakage is calculated to be higher than this, but the KPT method used incorporates several aspects of leakage into the fuel savings numbers. See section B.2. for further explanation.

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

Baseline Emissions (tCO2e)											
Carbon Flows		Project Year									
Offset Vintage	Stoves disseminated	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2007	18,000	28,780	53,109	42,346	30,236	18,127	7,549	1,496	0	0	0
2008	19,800	0	31,832	58,246	46,580	33,260	19,976	8,267	1,646	0	0
2009	21,780	0	0	35,015	64,071	51,238	36,666	21,893	9,094	1,810	0
2010	23,958	0	0	0	38,516	70,478	56,495	40,200	24,083	10,003	1,991
2011	26,354	0	0	0	0	42,368	77,720	61,950	44,220	26,491	11,015
2012	28,989	0	0	0	0	0	46,859	85,238	68,145	48,642	29,193
2013	31,888	0	0	0	0	0	0	51,545	93,762	74,959	53,624
2014	35,077	0	0	0	0	0	0	0	56,700	103,138	82,650
2015	38,585	0	0	0	0	0	0	0	0	62,370	113,737
2016	42,443	0	0	0	0	0	0	0	0	0	68,979
Total Annual Carbon Volumes (tCO2e)		**28,780**	**84,941**	**135,607**	**179,404**	**215,471**	**245,266**	**270,589**	**297,648**	**327,413**	**361,190**
								5-year total =		**644,201**	**tCO2e**
								10-year total =		**2,146,307**	**tCO2e**

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

Conservative Project Emission Reductions (tCO2e)		Fuel Savings Adjustment Factor:						1.00		Leakage:	0%
Carbon Flows		Project Year									
Offset Vintage	Stoves disseminated	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
2007	18,000	8,791	16,223	12,935	9,236	5,537	2,306	457	0	0	0
2008	19,800	0	9,724	17,792	14,229	10,160	6,102	2,525	503	0	0
2009	21,780	0	0	10,696	19,572	15,652	11,200	6,688	2,778	553	0
2010	23,958	0	0	0	11,765	21,529	17,257	12,280	7,356	3,056	608
2011	26,354	0	0	0	0	12,942	23,741	18,924	13,508	8,092	3,365
2012	28,989	0	0	0	0	0	14,314	26,037	20,816	14,859	8,918
2013	31,888	0	0	0	0	0	0	15,745	28,641	22,898	16,381
2014	35,077	0	0	0	0	0	0	0	17,320	31,505	25,247
2015	38,585	0	0	0	0	0	0	0	0	19,052	34,743
2016	42,443	0	0	0	0	0	0	0	0	0	21,071
Total Annual Carbon Volumes (tCO2e)		8,791	25,947	41,424	54,802	65,820	74,921	82,656	90,922	100,014	110,332
								5-year total =		196,783	tCO2e
								10-year total =		655,629	tCO2e

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

Year *	Estimation of project activity emissions (tons CO_2e)	Estimation of baseline emissions (tons CO2e)	Estimation of leakage (tonnes CO_2e)	Estimation of emission reductions (tons CO_2e)
2007-08	19,988	28,780	0	8,791
2008-09	58,994	84,941	0	25,947
2009-10	94,183	135,607	0	41,424
2010-11	124,601	179,404	0	54,802
2011-12	149,651	215,471	0	65,820
2012-13	170,345	245,266	0	74,921
2013-14	187,933	270,589	0	82,656
2014-15	206,726	297,648	0	90,922
2015-16	227,398	327,413	0	100,014
2016-17	250,858	361,190	0	110,332
Total	1,490,677	2,146,307	0	655,629

* Years start and end on 31 August.

SECTION F. Environmental impacts

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

The host country does not require an EIS. However, E+Co's investment officer Kofi Nketsia-Tabiri prepared an analysis of potential environmental impacts associated with the project and concluded that no adverse environmental impacts will take place as a result of the project activity (Annex 3).

SECTION G. Stakeholders' comments

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

The stakeholder consultation was announced in several ways. First, a list of potential stakeholders was compiled by all project participants that included a spectrum of government officials, NGOs, multilateral development organizations, end users and manufactures in Accra and elsewhere. For those stakeholders that had email addresses, invitations were sent via email. This letter is included below:

E+Co
ENERGY THROUGH ENTERPRISE

12 June, 2008

Dear Sir/Madam:

I am pleased to invite you to participate in a presentation and meeting to discuss the environmental and social impacts of a project that will disseminate improved household charcoal stoves in Ghana. The meeting will take place on Friday, 4 July, 2008 at 10:30am at the Aburi Botanical Gardens, located at Aburi in the Eastern Region in Ghana.

An overwhelming majority of households in Ghana cook using inefficient stoves that are fueled by charcoal. These inefficient stoves emit pollution that threatens human health and the environment, and their high charcoal requirement worsens deforestation. This new stove project will use carbon finance to help large populations shift away from using inefficient stoves and towards more efficient stoves that will protect public health and the environment.

We are seeking stakeholders' input on project design, to ensure that this endeavor is implemented in the most effective and beneficial way possible and takes into account national and local social and environmental issues.

Please feel free to share this invitation with interested colleagues and friends. Kindly RSVP to Erik Wurster at erik.wurster@eandco.net by 20 June, 2008. However, if you miss the RSVP deadline, please do not hesitate to attend anyway. We welcome all interested stakeholders to this event. We look forward to your attendance on 4 July, and to working with you to use efficient stoves to improve public health and curb deforestation in Ghana.

Sincerely,

Erik Wurster
Carbon Finance Officer
E+Co

E+Co
383 Franklin Street
Bloomfield, NJ 07003
Tel: +1-973-680-9100
Fax: +1-973-680-8066
www.EandCo.net

"Best in America" 2006, Independent Charities of America

Stakeholder invitation letter

For illiterate stakeholders, project participants relayed the invitation verbally. For invited guests who were unable to attend, stakeholder input was invited virtually via email. Finally, the invitation was posted in a local newspaper in Ghana. The advertisement appears below:

Advertisement

B&FT
Business & Financial Times
Ghana's leading Provider of Business Information

INSIDE
Ghana's reforms transform financial sector

bizliteracy
www.bizliteracy.com

Contact us to discuss your training needs

MONDAY, JUNE 30, 2008 ISSUE 912 PRICE: GH ¢1

PUBLISHED IN ASSOCIATION WITH BUSINESS IN AFRICA MAGAZINE FOUNDED: 1989

For more information, visit bftghanaonline.com

E+Co
ENERGY THROUGH ENTERPRISE

Carbon Finance Stakeholder Consultation

We are pleased to welcome you to a public meeting to discuss the environmental and social impacts of a project that will disseminate improved household charcoal stoves in Ghana using carbon finance. The meeting will take place on Friday, 4 July, 2008 at 10:30am at the Aburi Botanical Gardens, located at Aburi in the Eastern Region in Ghana.

Kindly RSVP to Pearl Mussey at 21-776507.

Stakeholders lacking their own transportation, such as artisans, manufacturers and retailers, were provided a bus to bring them to and from their place of work to enable their participation.

G.2. Summary of the comments received:

A total of 66 stakeholders from Ghana's government, NGO community, stove users, stove manufacturers, artisans and retailers convened to discuss the carbon finance project aimed at disseminating efficient household cookstoves in Ghana. Virtual input was also requested from the 22 invited guests who were unable to attend.

Multiple stakeholders stressed that the work is consistent with governmental development priorities and with the needs of the poor in Ghana. It is clear that the concept of efficient stoves is appropriate and beneficial in Ghana, and that cost is a significant barrier to widespread dissemination. Some people specifically cited women's disproportionate exposure to indoor air pollution in Ghana and this project's potential role in helping to address that situation. Government representatives explained that this project is in line with governmental development priorities.

Among possible areas for improved project design, respondents cited the need to ensure worker safety. They explained that noise was excessive during metal cladding manufacturing and that something should be done to protect the hearing of artisans.

Although the organizers stressed the purpose of the meeting throughout the event (to solicit input on project design), much of the Q&A session was dominated by politics surrounding this project and a competing carbon finance project that is being implemented simultaneously in Ghana. The meeting reinforced the useful message that collaboration between these two projects in Ghana is welcomed and beneficial at the local level, and should be encouraged to the extent possible. It also reinforced the need to address double counting and possible brand name issues of the stove in Ghana.

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

Among project design changes directly resulting from input from the stakeholder consultation, TEL will begin to pay close attention to the extent to which their scale up of manufacturing will adversely affect the environment. They will consider proper disposal of toxic chemicals such as paint, fuel sources for firing kilns and lower impact methods to gather clay with which to manufacture ceramic liners. They now store used paint, paint solvents and other toxic materials in containers that they periodically empty in the proper disposal facilities. They have begun to use palm kernel shells to fire their kilns rather than the business-as-usual non-renewable biomass used in most Ghanaian kilns. Finally, TEL works with a local counterpart to ensure that clay is harvested with minimal impact. Among the methods used, their counterpart refills holes used to mine clay and is using some of the holes as test cases to begin fish farming so that the holes can act as an input for another industry and an additional income source.

Since noise from manufacturing metal cladding from scrap metal was identified by stakeholders as a significant source of concern for worker safety, TEL now distributes ear plugs that will ensure minimal hearing damage among artisans from their work environment.

Finally, TEL decided to change their brand name from Gyapa to Toyola Coalpot to avoid any ambiguity between the two carbon finance projects that exist in Ghana.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Toyola Energy Limited (TEL)
Street/P.O.Box:	Sarpeiman Village
Building:	
City:	Greater Accra Region,
State/Region:	Accra
Postfix/ZIP:	
Country:	Ghana
Telephone:	
FAX:	
E-Mail:	
URL:	
Represented by:	
Title:	Entrepreneur and managing director of TEL
Salutation:	Mr.
Last Name:	Ologburo
Middle Name:	Wahab
First Name:	Suraj
Department:	
Mobile:	+233 24 548 2842
Direct FAX:	
Direct tel:	
Personal E-Mail:	toyolaenergy@yahoo.com

Organization:	E+Carbon
Street/P.O.Box:	383 Franklin St.
Building:	
City:	Bloomfield
State/Region:	New Jersey
Postfix/ZIP:	07003
Country:	USA
Telephone:	+1.917.225.0125
FAX:	
E-Mail:	
URL:	www.eandco.net
Represented by:	
Title:	Manager, Carbon Finance
Salutation:	Mr.
Last Name:	Wurster
Middle Name:	Frederick
First Name:	Erik
Department:	
Mobile:	
Direct FAX:	
Direct tel:	
Personal E-Mail:	erik.wurster@eandco.net

ANNEX 2

BASELINE INFORMATION

Data / Parameter:	$EF_{bl.bio,co2}$
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
Value applied:	1.747
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{pj.bio,co2}$
Data unit:	tCO2/t_biomass
Description:	CO2 emission factor arising from use of wood-fuel in project scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, Tables 1.2/1.4
Value applied:	1.747
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{bl.bio,non-co2}$
Data unit:	tCO2/t_biomass
Description:	Non-CO2 emission factor arising from use of wood-fuel in baseline scenario
Source of data:	CH4 and N2O: IPCC 2006 GL for emission factors and NCVs, IPCC SAR 1996 for GWPs.
Value applied:	0.455
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{pj.bio,non-co2}$
Data unit:	tCO2/t_biomass
Description:	Non-CO2 emission factor arising from use of wood-fuel in project scenario
Source of data:	CH4 and N2O: IPCC 2006 GL for emission factors and NCVs, IPCC SAR 1996 for GWPs.
Value applied:	0.455
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{ch,prod,co2}$
Data unit:	tCO2/t_ch
Description:	CO2 emission factor arising from production of charcoal
Source of data:	Emissions of greenhouse gases and other airborne pollutants from charcoal making in Kenya and Brazil, David M. Pennise, Kirk R. Smith, Environmental Health Sciences, University of California, Berkeley, California. Journal of Geophysical Research Vol 106 October 27 2001.
Value applied:	1.802
Justification of data choice or description of measurement methods and procedures actually applied:	There are no IPCC default values available. Therefore, scenario-specific values are applied. The methodology allows for emission reductions from production of fuels (section II, Part 1). The published emission factors in use here are found in Table 6A of the above referenced paper. This table calculates the averages of measured emissions of greenhouse gases from earth mound kilns. Although these measurements were taken in Kenya there is clear evidence that the same techniques for charcoal production are used currently in Ghana[63].
Any comment:	

Data / Parameter:	$EF_{ch,prod,non-co2}$
Data unit:	tCO2/t_ch
Description:	Non-CO2 emission factor arising from production of charcoal
Source of data:	CO2, CH4, N2O GWPs from (IPCC SAR 1996).
Value applied:	0.983
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{ch,use,co2}$
Data unit:	tCO2/t_ch
Description:	CO2 emission factor arising from consumption of charcoal
Source of data:	Product of NCVch (IPCC 2006 GL default 29.5 MJ/kg) and Emission factor (energy basis) for charcoal (IPCCC 2006 GL default 112 tCO2/TJ) x 10^-3
Value applied:	3.304
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.
Any comment:	

Data / Parameter:	$EF_{ch,use,non-co2}$
Data unit:	tCO2/t_ch
Description:	Non-CO2 emission factor arising from consumption of charcoal
Source of data:	CH4 and N2O: IPCC 2006 GL for emission factors and NCVs, IPCC SAR 1996 for GWPs.
Value applied:	0.255
Justification of data choice or description of measurement methods and procedures actually applied:	Default IPCC values for wood / wood waste are applied.

[63] Mason, John R. Charcoal Production in Ghana: Building a Sustainable Model based on Community Management and Payments for Ecosystem Services. NCRC, Accra, Ghana. Accessed on 18 August, 2009: http://www.katoombagroup.org/documents/events/event18/NCRCsustainablecharcoalSept08.pdf

Any comment:	

Other Baseline Information

Description	Parameter	Value	Units	Source
Non-Renewable Biomass Baseline (charcoal)				
Fractional Non-Renewability	%NRbio,ch,yr	73%	fractional	2008 Baseline Study, Project-Specific, as detailed in section B.2.2 of the PDD
Non-Renewable Biomass Baseline (wood)				
Fractional Non-Renewability	%NRbio,wd,yr	73%	fractional	2008 Baseline Study, Project-Specific, as detailed in section B.2.2 of the PDD
Leakage				
Net Leakage	LE	0.00	fractional	2008 Baseline and Monitoring KS
Cumulative Usage				
Usage rate after 1st year	Ubio,ch,yr1	0.90	fractional	conservative projection
Usage rate after 2nd year	Ubio,ch,yr2	0.70	fractional	conservative projection
Usage rate after 3rd year	Ubio,ch,yr3	0.50	fractional	conservative projection
Usage rate after 4th year	Ubio,ch,yr4	0.30	fractional	conservative projection
Usage rate after 5th year	Ubio,ch,yr5	0.10	fractional	conservative projection
Usage rate after 6th year	Ubio,ch,yr6	0.00	fractional	conservative projection
Average Daily Household Consumption (charcoal)				
Baseline	Fbio,ch,yr0	1.500	kg_ch / hh_day	2008 Baseline KPT Study
Project, 1st year	Fbio,ch,yr1	1.000	kg_ch / hh_day	2008 Baseline KPT Study
Project, 2nd year	Fbio,ch,yr2	1.000	kg_ch / hh_day	Conservative projection
Project, 3rd year	Fbio,ch,yr3	1.000	kg_ch / hh_day	Conservative projection
Project, 4th year	Fbio,ch,yr4	1.000	kg_ch / hh_day	Conservative projection
Project, 5th year	Fbio,ch,yr5	1.000	kg_ch / hh_day	Conservative projection
Average Daily Household Consumption (wood)				
Baseline	Fbio,wd,yr0	1.080	kg_ch / hh_day	2008 Baseline KPT Study
Project, 1st year	Fbio,wd,yr1	0.870	kg_ch / hh_day	2008 Baseline KPT Study
Project, 2nd year	Fbio,wd,yr2	0.870	kg_ch / hh_day	Conservative projection
Project, 3rd year	Fbio,wd,yr3	0.870	kg_ch / hh_day	Conservative projection
Project, 4th year	Fbio,wd,yr4	0.870	kg_ch / hh_day	Conservative projection
Project, 5th year	Fbio,wd,yr5	0.870	kg_ch / hh_day	Conservative projection
Prevalence of HH wood consumption		30%	fractional	2008 Baseline and Monitoring KS

Detailed Carbon Projections

Fuel-Specific Parameters

	Type of fuel	Avg. NRB	EF CO2	EF CH4	EF N2O	Baseline Fuel Consumption	Project Fuel Consumption	Average Fuel Savings
		%	tCO2	tCO2e	tCO2e	kg/hh_day	kg/hh_day	kg/hh_day
Biomass 1	**Charcoal**	73.00%	5.106	1.141	0.096	1.50	1.00	0.50
Biomass 2	**Wood**	73.00%	1.747	0.401	0.054	1.08	0.87	0.21
Biomass 3	0	0.00%	0	0	0	0.00	0.00	0.00
Alternative fuel 1	0	-	0	0	0	0.00	0.00	0.00
Alternative fuel 2	0	-	0	0	0	0.00	0.00	0.00
Alternative fuel 3	0	-	0	0	0	0.00	0.00	0.00

Stove sales and Usage Parameters

Initial Sales (1st year)	18000
Annual Sales Growth (%)	10%
Avg. Annual Leakage (%)	0%
KS Adjustment Factor	1.00
Avg. Annual Sales	28687
Avg. Stove lifetime (yrs)	3

Annual Usage and Sales Rates

	1	2	3	4	5	6	7	8	9	10
Project Year	1	2	3	4	5	6	7	8	9	10
Calendar Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Stove Usage Rate: (% in use at end of year)	90%	70%	50%	30%	10%	0%	0%	0%	0%	0%
Annual Sales:	**18,000**	**19,800**	**21,780**	**23,958**	**26,354**	**28,989**	**31,888**	**35,077**	**38,585**	**42,443**

Conservative Project Emission Reductions (tCO2e)

Fuel Savings Adjustment Factor:	**1.00**
Leakage:	**0%**

Carbon Flows — **Project Year**

Offset Vintage	**Stoves disseminated**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
2007	18,000	8,791	16,223	12,935	9,236	5,537	2,306	457	0	0	0
2008	19,800	0	9,724	17,792	14,229	10,160	6,102	2,525	503	0	0
2009	21,780	0	0	10,696	19,572	15,652	11,200	6,688	2,778	553	0
2010	23,958	0	0	0	11,765	21,529	17,257	12,280	7,356	3,056	608
2011	26,354	0	0	0	0	12,942	23,741	18,924	13,508	8,092	3,365
2012	28,989	0	0	0	0	0	14,314	26,037	20,816	14,859	8,918
2013	31,888	0	0	0	0	0	0	15,745	28,641	22,898	16,381
2014	35,077	0	0	0	0	0	0	0	17,320	31,505	25,247
2015	38,585	0	0	0	0	0	0	0	0	19,052	34,743
2016	42,443	0	0	0	0	0	0	0	0	0	21,071
0	**Carbon Volumes (tCO2e)**	**8,791**	**25,947**	**41,424**	**54,802**	**65,820**	**74,921**	**82,656**	**90,922**	**100,014**	**110,332**

5-year total =	**196,783**	**tCO2e**
10-year total =	**655,629**	**tCO2e**

Annex 3

MONITORING PLAN

See section D for detailed outline of the monitoring plan. E+Co has regional monitoring and evaluation officers that will assess TEL's progress on a regular basis. In addition, E+Carbon has hired specialists to perform various quarterly and bi-annual tests to be verified on a regular basis, as outlined in section D.

Specific variables to be monitored (Alternative fuels variables in methodology omitted since they are not applicable to this project activity):

Data / Parameter:	Xnrb,bl,y
Data unit:	Fraction
Description:	Non-renewability status of woody biomass fuel in year y in baseline scenario
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Xnrb,pj,y
Data unit:	Fraction
Description:	Non-renewability of woody biomass fuel in year y in project scenario
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Leakage
Data unit:	t_CO2e per year
Description:	Potential GHG emissions outside project boundary caused by project activity
Source of data:	Study
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Bbl,y
Data unit:	t_biomass/unit-year
Description:	Mass of woody biomass combusted in the baseline in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Bpj,,y
Data unit:	t_biomass/unit-year
Description:	Mass of woody biomass combusted in the project in year y
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report

Any comment:	

Data / Parameter:	Usage in year y
Data unit:	Fraction
Description:	Percentage of stoves of age x remaining in use in year y
Source of data:	Survey
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	Age
Data unit:	Fraction
Description:	Adjustment to values of $B_{pj,,y}$ and $AF_{pj,i,y}$ for stoves of age x
Source of data:	Survey
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

Data / Parameter:	New Stove
Data unit:	Fraction
Description:	Adjustment to values of $B_{pj,,y}$ and $AF_{pj,i,y}$ for new stove models
Source of data:	Measurements of sample or whole of cluster population
Monitoring frequency:	Bi-annual
QA/QC procedures:	3rd party study and report
Any comment:	

The host country does not require an EIS. However, E+Co's investment officer Kofi Nketsia-Tabiri prepared an analysis of potential environmental impacts associated with the project and concluded that no adverse environmental impacts will take place as a result of the project activity, which is found below.

E+CO'S ENVIRONMENTAL CHECKLIST

Investment Name: Toyola Energy Limited
Investment Officer: Kofi Nketsia-Tabiri #06-294
Completed: May 2006

Toyola Energy limited will provide clean and efficient cooking power to Ghana's households, small businesses and institutions by manufacturing and marketing improved biomass cooking stoves. Toyola will also fabricate and market low cost LPG stoves from the byproduct of the production process.

EXCLUSION LIST

E+Co's exclusion list details activities with the potential to pose unacceptable social and environmental risks. Does the investment involve any of the following activities?

- Production or activities involving harmful or exploitative forms of child labor NO
- Production or trade in any product or activity deemed illegal under host country laws or regulations or international conventions and agreements NO
- Production or trade in weapons and munitions NO
- Production or trade in alcoholic beverages (excluding beer and wine) NO

- Production or trade in tobacco NO
- Gambling casinos and equivalent enterprises NO
- Trade in wildlife or wildlife products regulated under Convention on International Endangered Species (CITES) NO
- Production or trade in radioactive materials NO
- Production or trade in or use of unbonded asbestos fibers NO
- Commercial logging operations/purchase of logging equipment for use in primary tropical moist forest NO
- Production or trade in products containing PCBS NO
- Production or trade in pharmaceuticals subject to phase outs or bans NO
- Production or trade in ozone depleting substances subject to phase out NO
- Drift net fishing in the marine environment using nets in excess of 2 km in length NO

    - Yes. E+CO FUNDS CANNOT BE USED FOR THIS INVESTMENT.
    - No. Go to #1

1. Does the investment involve any of the following:
    - Construction of a new facility NO
    - Expansion of a facility onto undeveloped land NO
    - Moderization of an existing facility NO
    - Real property held as collateral NO
    - Any other significant environmental issues? NO

        - Yes. Go to #2
        - No. Clear project (Category C: No Environmental Impact) NO

1. Does the investment involve any of the following:
    - Dams and Reservoirs NO
    - Forestry projects NO
    - Large-scale industrial plants and estates NO
    - Major oil and gas developments, including major pipelines NO
    - Large thermal and hydropower developments NO
    - Manufacturer, transportation, and major use of hazardous and/or toxic materials NO
    - Domestic and hazardous waste disposal operations NO
    - Other sectors for which local legislation Environmental Impact Assessment NO

        - Yes. Discuss with the Environmental Manager an environmental impact assessment, public consultation and disclosure of environmental information.
            - Is an EIA already done or planned? Please comment: ____________________
              ____

        - No. Go to #3.

3. Does the investment involve any of the following:
   - ❑ Pest management (significant use of man-made pesticides/agrochemicals) NO
   - ❑ Impacts on indigenous peoples NO
   - ❑ Impacts on critical natural habitats (significant downgrading or conversion) NO
   - ❑ Involuntary or major resettlement (involuntary loss of land, housing/livelihood) NO
   - ❑ Forests (commercial logging operations or logging in primary tropical moist forests) NO
   - ❑ Impacts on international waterways NO
   - ❑ Impacts on cultural property (e.g., burial grounds, monuments, shrines) NO
   - ❑ Dam safety (dams over 15 meters high) NO

   - ❑ Yes. The Environmental Manager should be contacted directly to determine next steps.

   - ❑ No. The Investment is likely to be category B, Go to #4.

4. MAJOR HAZARDS
   - ❑ **Are hazardous materials used in the project? (e.g., flammable, explosive, reactive, radioactive and/or toxic substances including pesticides).** NO
   - ❑ **Are they handled, stored, transported and disposed of in accordance with material safety guidelines?** NO

   - ❑ Yes. Contact Environmental Manager to assess need for major hazard assessment.
   - ❑ No. Go to #5

5. Environmental and Health Impact

Air Emissions
- ❑ Visible or readily noticeable air emission? NO
- ❑ Excessive noise or odor onsite or in vicinity? NO
- ❑ Use of CFCs or other ozone depleting substances? NO

Water Use
- ❑ Are water supplies diverted from other upstream or downstream users? NO
- ❑ Discharge permitted to municipal sewer without operational sewage treatment works? NO

   - ❑ If Yes to Any Question. Contact Environmental Manager to assess need for compliance evaluation.
   - ❑ No.

Solid Waste
- ❑ Proper disposal available for solid waste? (landfill, private collector, municipality)Not applicable
- ❑ Hazardous waste properly disposed of? How is it disposed of ____________?N/A

Fire Protection

- Adequate fire protection in place (serviced fire extinguishers, hydrants with hoses, signs for the equipment and safety practice, smoke/heat sensors, alarm system connected to these sensors, fire exits well marked and convenient?)Not applicable

  - If No to Any Question. Contact Environmental Manager to assess need for compliance evaluation.
  - Yes. Go to #6

6. **SITE CONTAMINATION**

Can you detect any signals of contamination (I) at the project site, (II) at sites designed as collateral, or (III) at sites adjacent that may contaminate them? These may include the following:

- Discolored wells, pits or ponds NO
- Incinerators NO
- Improperly stores containers NO
- Leaking pipelines NO
- Stained surface areas (non-water) NO
- Stressed or dead flora/fauna NO
- Used automotive/industrial batteries NO
- Manmade sinkholes, heaps NO
- Landfills, junkyards NO
- Underground storage tanks NO
- Above ground storage tanks NO
- Leaking equipment NO
- Flaking asbestos on insulation NO
- Radon emissions (inquire) NO
- Irritation of the eyes or skin NO
- Escaping gas, smoke, vapors, chemical odors NO

  - Yes. Contact Environmental Manager to assess need for site assessment or environmental audit.
  - No. Go to Question #7

7. Harmful child and forced labor - Mark the box with the most appropriate and accurate response to the statement:

	YES	NO	Unsure
The investment prospect is engaged in any activity employing forced labor.		NO	
The investment prospect complies with all of the country's labor laws.	YES		
The investment prospect has effective age verification procedures for all employees.	YES		
The investment prospect has a minimum age for employment. What is this age? 18 (ILO and Regional legal provisions ban employment for children under 15, with few exceptions)	YES		
Are all employees made aware of the minimum age for employment?	YES		
What overall Workplace Health and Safety standards and practices has the investment prospect implemented? Is	YES, Mr. Suraj Wahab O the entrepreneur and managing director of Toyola is		

there a person responsible for these policies at the company?	responsible for the administration of the company;

The M&E Officers will be collecting information on government policies related to child labor. E+Co's parameters related to labor will be developed more fully during the first quarter of 2006.

Please refer to the materials distributed at the E+Co Global Meeting in November 2005 for more information on the Environment Checklist (specifically sections 4 and 5). Appendix 1 contains definitions of the Category A, B and C classification.

Final Comments: Are there any other issues related to environmental and social impact?

The company will be purchasing a truck for raw material purchases and distribution of the stoves. The efficient stove still requires charcoal to function but at a lesser amount than the traditional stove.

This Investment is Classified as a Category: C

Rationale, if needed:

____

____

Environmental Manager: ***Approved by Gina Rodolico, May 2, 2006***

ANNEX 4

LEGAL DOCUMENTATION

This annex offers legal documentation to help prove that double counting can be avoided. There are other carbon offset projects currently being planned from stoves in Ghana, and proper documentation is required to be sure that these projects do not count one stove as part of both of their projects. As requested by Gold Standard, this project will cross check sales records with the other project in Ghana to avoid double counting. In addition to this procedure, Toyola Coalpot stoves are uniquely identifiable in the field. Specifically, Toyola Coalpot stoves lack 3 legs on the bottom, which improved stoves from other projects have. Moreover, Toyola Coalpot stoves are a different diameter than other improved coalpot stoves in Ghana. The diameter of Toyola Coalpoat stoves are as follows, allowing them to be uniquely identified in the field. No other improved stoves are sold in Ghana with these exact diameters:

a. improved fuel-efficient household charcoal stoves (small) - 260mm
b. improved fuel-efficient household charcoal stoves (medium) - 350mm
c. improved fuel-efficient commercial charcoal stoves (small) - 410mm
d. improved fuel-efficient commercial charcoal stoves (large) - 500mm

It is important to note that design changes that differentiate the Toyola Coalpot from the GYAPA were gradual. In fact, the name was the last thing to change among the different design characteristics. That is, there are stoves sold during the first year of the project that were sold under the GYAPA name by Toyola that lack three legs and that incorporate the updated diameters.

Sample Rebate Card

Serial number: 000001

Rebate Card (Good for GHC1)

(Front of card - Toyola Copy)

Completing and signing this card will make you eligible for a refund of GHC1 on your purchase if Toyola Energy Ltd. is approved for carbon finance. See reverse side for more details.

Date of purchase (DD/MM/YY): ________________________________

Number of stoves purchased:

☐ Household (small) ☐ Household (large) ☐ Commercial (medium) ☐ Commercial (large)

Sales outlet ID (see reverse side for ID codes): _____________________

Personal details

Surname: ________________ First name: _____________

Telephone numbers

Tel 1: ____________ Tel 2: ____________

Complete address

Street: ____________________ P.O. Box: _____________

Zone: _____________________ City: _________________

Serial number: 000001

Toyola Energy Ltd

Rebate Card (Good for GHC1)

(Front of card - Customer copy)

Completing and signing this card will make you eligible for a refund of GHC1 on your purchase if Toyola Energy Ltd. is approved for carbon finance. See reverse side for more details.

Date of purchase (DD/MM/YY): __________________________________

Number of stoves purchased:

☐ Household (small) ☐ Household (large) ☐ Commercial (medium) ☐ Commercial (large)

Sales outlet ID (see reverse side for ID codes): ______________________

Personal details

Surname: _________________ First name: ______________

Telephone numbers
Tel 1: _____________ Tel 2: _____________

Complete address

Street: ____________________ P.O. Box: _____________

Zone: _____________________ City: _________________

(Back of card – Toyola copy)

Carbon finance and Toyola:

Companies and individuals around the world are increasingly trying to decrease greenhouse gas emissions as an attempt to address climate change. One way to do this is to subsidize clean energy technologies through carbon finance. Toyola is currently applying to have their stoves included in a program in which individuals and companies will pay to enable Toyola to lower their prices, thereby increasing sales. If the project is approved, your refund of GHC1 will come from this source. Around February, 2009, if their carbon finance project is approved Toyola will contact you using the information provided here to offer you the rebate. As part of this project, Toyola or its affiliates may also contact you to perform a survey that evaluates the effectiveness and impact of your stove.

Waiver:

As means to fund the rebate contemplated here, I hereby assign and transfer all right, title and interest to carbon offsets arising from this stove's use to Toyola Energy Ltd., and I hereby permanently waive any claim or right to such offsets.

Signature

Sales Outlet	Sales Outlet ID
Direct sales	001

Sales Outlet	Sales Outlet ID

(Back of card – Customer copy)

Toyola Energy Ltd

Carbon finance and Toyola:

Companies and individuals around the world are increasingly trying to decrease greenhouse gas emissions as an attempt to address climate change. One way to do this is to subsidize clean energy technologies through carbon finance. Toyola is currently applying to have their stoves included in a program in which individuals and companies will pay to enable Toyola to lower their prices, thereby increasing sales. If the project is approved, your refund of GHC1 will come from this source. After February, 2009, you can learn whether the project has been approved and we can offer the rebate on your purchase. As part of this project, Toyola or its affiliates may contact you to perform a survey that evaluates the effectiveness and impact of your stove.

Waiver:

As means to fund the rebate contemplated here, I hereby assign and transfer all right, title and interest to carbon offsets arising from this stove's use to Toyola Energy Ltd., and I hereby permanently waive any claim or right to such offsets.

Sales Outlet	Sales Outlet ID
Direct sales	001

Sales Outlet	Sales Outlet ID

Letter of agreement

This was signed between TEL and E+Carbon on 31/08/2007.

(to be inserted if Gold Standard agrees with E+Carbon that such documentation is necessary to avoid double counting in competitive carbon markets)

ERPA + Amendment

(to be inserted if Gold Standard agrees with E+Carbon that such documentation is necessary to avoid double counting in competitive carbon markets)

2nd tier ERPAs

2nd tier ERPAs are already signed for 17 artisans and companies that supply TEL with stove components.

(to be inserted if Gold Standard agrees with E+Carbon that such documentation is necessary to avoid double counting in competitive carbon markets)

ANNEX 5

Stakeholder consultation minutes

Friday, 4 July, 2008, 10:30 am - 1 pm
Aburi Botanical Gardens, Aburi, Ghana

Summary

A total of 66 stakeholders from Ghana's government, NGO community, stove users, stove manufacturers, artisans and retailers convened to discuss the carbon finance project aimed at disseminating efficient household cookstoves in Ghana. Virtual input was also requested from the 22 invited guests who were unable to attend.

Multiple stakeholders stressed that the work is consistent with governmental development priorities and with the needs of the poor in Ghana. It is clear that the concept of efficient stoves is appropriate and beneficial in Ghana, and that cost is a significant barrier to widespread dissemination. Some people specifically cited women's disproportionate exposure to indoor air pollution in Ghana and this project's potential role in helping to address that situation. Government representatives explained that this project is in line with governmental development priorities.

Among possible areas for improved project design, respondents cited to need to ensure worker safety. They explained that noise was excessive during metal cladding manufacturing and that something should be done to protect the hearing of artisans.

Although the organizers stressed the purpose of the meeting throughout the event (to solicit input on project design), much of the Q&A session was dominated by politics surrounding this project and a competing carbon finance project that is being implemented simultaneously in Ghana. The meeting reinforced the useful message that collaboration between these two projects in Ghana is welcomed and beneficial at the local level, and should be encouraged to the extent possible. It also reinforced the need to address double counting and possible brand name issues of the stove in Ghana.

Introduction

Erik Wurster introduced E+Co and Toyola and reminded attendees that the purpose of the meeting is to gather their opinions on the project, its design and its applicability to Ghana's situation. He then introduced his colleagues that were helping to host the meeting. Staff hosting the meeting included:

Erik Wurster – Mr. Wurster is a Carbon Finance Officer for E+Carbon and is based in Boston. He spends extensive time in the field implementing E+Carbon's carbon finance activities worldwide.

Catherine Diam – Ms. Diam is a Monitoring and Evaluation officer for E+Co. A Senegalese national, she is based in E+Co's New Jersey office but spends about 50% of her time in the field in West Africa.

Vincent Yankey – Mr. Yankey is E+Co's investment officer for Ghana, based in Accra.

Karla Gonzalez – Ms. Gonzalez is E+Co's Monitoring and Evaluation Officer for the Central America region, and is based in Costa Rica.

Pearl Mussey – Ms. Mussey is E+Co's office manager in Ghana.

Presentation summary

Mr. Wurster offered a summary of the project in the form of a PowerPoint presentation that included background information on carbon finance and emissions trading, as well as a profile of traditional cooking practices in Ghana. He stressed the social, environmental and health benefits of widespread use of efficient cookstoves and shared with the public the proposed use of future carbon revenues. The presentation was translated into Twi by Ernest Kyei, one of Toyola's entrepreneurs.

Question and answer session

Dr Ahmad Addo (KNUST) - Have there been any studies on CO_2 emissions from efficient cookstoves?

Erik Wurster - There have been several studies done in and outside of Ghana. For the current project, data was pulled from previous studies but E+Carbon also hired a 3rd party to perform kitchen tests on a representative sample of households that are using Toyola's stoves.

Wisdom Togobo (Ministry of Energy) - He thanked E+Co and Toyola for their efforts to promote the use of efficient cookstoves in Ghana. The dissemination of these cookstoves is one of the policy objectives of the Ministry of Energy. The Gyapa stove has been in the market for several years. Enterprise Works has been active in promoting it but one of the major setbacks of a widespread dissemination has been cost. E+Co's support will hopefully help to make the stove more affordable. However, carbon finance would have a greater impact if E+Co could extend its services to other distributors rather than working with only one. Additionally, E+Co and Enterprise Works should work together to avoid duplicating efforts given that Enterprise Works is also implementing a carbon finance project on Gyapa stoves in Ghana.

Mina Lassey (Enterprise Works Ghana) – She stated that Toyola is one of Enterprise Works (EW) distributors and that it would have been desirable for E+Co to better inform EW about the project.

Erik Wurster responded that E+Co has made every effort to collaborate with Pioneer Carbon, the carbon developer working with Enterprise Works, on ways to combine their carbon finance projects for cookstoves in Ghana but the two parties were unable to reach consensus regarding the distribution of carbon revenues. He had also had meetings with the head of Eneterprise Works Ghana and discussed the matter with Enterprise Works' Executive Director in Washington DC. He pointed out that the main reason for a lack of cooperation was that E+Co was convinced that, with Pioneer's inclusion, far too much carbon revenues would be taken out of the field and away from their intended use: to improve public health and curb deforestation in Ghana.

Seth Mahu (Technical carbon consultant for Enterprise Works) - He raised concerns about the lack of Enterprise Works recognition in the project summary that was distributed at the beginning of the meeting. He indicated that the document is portraying Toyola as the architect of efficient cookstoves in Ghana whereas Enterprise Works started the process of promoting this stove in 2002 and developed a strong supply chain, of which Toyola is currently taking advantage. Over the years, Enterprise Works has trained Toyola and many other stove manufacturers in the country, therefore it would be inaccurate to say that

Toyola developed the concept of stove distribution in Ghana. He also wanted to know how the project will address double counting. He suggested that E+Co and Enterprise Works meet again to resolve lingering issues.

Erik agreed that Enterprise Works should receive credit for the good work that they have already done. Although this credit is included in the PDD, it did not make it into the project summary, which was a mistake. Erik acknowledged that double counting is a serious issue, not only for this project but also for all carbon finance projects that are being developed simultaneously in one country and using the same, geographically dispersed technology. He recently sent a memo to Gold Standard to draw their attention to that issue, which he offered to share with Mr. Mahu.

Ernest Kyei added that Toyola is now expanding into the solar business in addition to stoves. He displayed the solar lanterns and solar powered charging stations that the company has recently introduced, and explained that additional discussions are ongoing between E+Co and Toyola to develop carbon finance assets from solar technology.

Suraj Wahab acknowledged Enterprise Works' support but emphasized that his business would not have been successful without the financial support of E+Co. Prior to E+Co's loan, the company was selling stoves in Accra only. The financing has allowed him to take the stoves to customers in rural areas and reach a much larger geographical area, which he argues was the critical input to his business model. He welcomed the idea of reopening the dialogue with Enterprise Works.

Wisdom Tobogo suggested that this forum not be used to settle differences between Enterprise Works, E+Co and Toyola, but recommended that the documentation acknowledge the role of Enterprise Work in the dissemination of Gyapa cookstoves in Ghana. Regarding the solar energy portion of Toyola's activities, he reiterated that all of these efforts fit within the policy objective of the Ministry of Energy and indicated that the Ministry has recently developed a fund to subsidize solar home systems by up to 50% in areas not connected to the grid. This fund combined with carbon revenues should significantly reduce the upfront cost of solar energy systems for the local population. He invited all parties to put their differences aside to work for the common goal of increasing access to clean energy and reducing CO_2 emissions.

Erik echoed Wisdom's statement and reminded people that never before have rural energy and sustainable development enjoyed so much attention from financial institutions. Now is the time to mobilize significant capital from mainstream financial institutions to solve energy poverty.

Baba Adongo of Technoserve commented that the involvement of Enterprise Works in the cookstove business should be made clear in the project document.

Erik clarified that the full project design document outlines the training that Enterprise Works provided to stove manufacturers in Ghana and offered to send the document via e-mail to Mr. Adongo. However , he reminded him that Enterprise Works is not part of the contract between E+Co and Toyola on this project and therefore should not play be featured prominently in the project design document. Among other things, the project design document is meant to outline the central barriers to industry growth. Technical training for manufacturers, which Enterprise Works has already provided, has not been identified as a barrier to industry growth.

Gold Standard questionnaire

After the Q&A session, Erik highlighted the purpose of the questionnaire and explained that assistance and translation of the questionnaire in Twi would be provided in the back of room. Attendees who preferred that option formed 3 small groups in the back of the room and were assisted by 3 translators to complete questionnaires. All original, hand written questionnaires are available upon request.

Quantitative response summaries broken down by question
(Note that not all respondents answered each question)
Range of responses for environmental impacts

Question #	Environmental Impacts		Is this likely to result in a significant effect?		Brief response summary
	Yes	No	Yes	No	
1	3	66	0	30	The execution and construction of the project will affect natural resources in a positive way. It will save forest resources and emissions, and decrease consumption of non-renewable biomass. The overwhelming majority of respondents did not cite any effects. One respondent noted that collection of clay for ceramic production may affect the ecosystem, however, the effect will depend upon the collection method employed.
2	0	67	0	32	No respondents indicated that the project activity will use substances that could harm the environment..
3	1	30		18	Nearly all respondents claim that contamination of air is not an issue with the project.
4	1	43		19	Causing light, heat, noise, vibration or electromagnetic radiation was not identified as a concern.
5	2	40	2	19	Most respondents claim there is no risk of pollution or contamination of nature.
6	11	31		18	There are no protected areas that will be adversely affected by the project.
7		32		17	Any adverse effects resulting from manufacturing will only occur in urban and peri-urban areas since the manufacturing facilities are near towns and cities.
8		33		18	There is no evidence to suggest that manufacturing, selling or using fuel efficient stoves will have a negative effect on sensitive species.
9		44		18	No.
10		44		18	No. Of the natural disasters listed, the project can only have a positive effect, such as decreasing incidence of landslides due to curbed deforestation.

					Such natural disasters are not common in Ghana.

Range of responses for socioeconomic and health impacts

Question #	Socioeconomic and Health Impacts		Is this likely to result in a significant effect?		Brief response summary
	Yes	No	Yes	No	
11	5	30	0	11	Respondents did not identify any significant risks to human health.
12	0	35	0	12	Respondents noted that wood is required to fire the kilns, however, this would be more than compensated for by saved charcoal from the project. Moreover, recent design changes in the project activity has begun to use to palm kernel shells as a fuel to fire kilns. This is a renewable source of biomass.
13		35		9	No.
14		34		9	Pollution will be insignificant.
15	5	18	3	8	There were no significant risks identified.
16	23	17	8	6	Of those who cited an effect, most noted an increase in employment as a result of the project activity.
17	2	23	2	10	No.
18	2	22		8	No.
19	17	20	2	8	Only retail sales activity will be highly visible, as it should be. The stoves will be used in households and communities, which all also be visible.
20	1	34	1	11	No, the manufacturing facility is located far from these places.
21	3	34		10	No.
22		35		7	Stoves are produced in a confined area that does not have any such resources.
23	2	33	2	7	No. Of the natural disasters listed, the project can only have a positive effect.

Sign in sheet of all stakeholders in attendance

Ghana Stakeholder Consultation Sign in Sheet

	Surname	Given name	Circle one	Name of NGO, gov agency, or University, if applicable	Position	Postal address	Email address, if available	Phone number	Signature (sign as you leave)
1	Amoso	Josephine	stove user / manufacturer / distributor / NGO government / Academia		Gya pa Seller	Sapeiman			
2	Frams	Kate	stove user / manufacturer / distributor / NGO government / Academia		Chop bar operator	P.O Box 104 Aburi		0243286113	
3	Ofeibea	Mercy	stove user / manufacturer / distributor / NGO government / Academia		Restaurant operator	Po Box 1174 Aburi		0243858818	
4	Opoku	Cynthia	stove user / manufacturer / distributor / NGO government / Academia		Restaurant Cook	P.o Box 1174 Aburi		0207045690	
5	Obije	Patrick	stove user / manufacturer / distributor / NGO government / Academia	Restoration Gate [illegible] Centre	Distributor user	P.o.Box 266 [illegible]	[illegible]@hotmail.com	024413-2293	[signature]
6	[illegible]	Seth	stove user / manufacturer / distributor / NGO government / Academia	IWG	PM	Dzowulu Accra	[illegible]@yahoo.com	[illegible]	[signature]
7	Lassey	Mina	stove user / manufacturer / distributor / NGO government / Academia	IWG	M&E	Dzowulu Accra	manissahus@yahoo.com	020 9211219	[signature]
1	Dramani Ahmed		stove user / manufacturer / distributor / NGO government / Academia	—	—	Mankessim C/R	—	0244549503	
2	Ebeng	David	stove user / manufacturer / distributor / NGO government / Academia	—	—	Asamankese	—	0273332268	
3	Osmanu	Ofuni	stove user / manufacturer / distributor / NGO government / Academia						
4	Francois	Kwasi	stove user / manufacturer / distributor / NGO government / Academia					0242010452	
5	Apedja	Michael	stove user / manufacturer / distributor / NGO government / Academia						
6	Issa	Yakubu	stove user / manufacturer / distributor / NGO government / Academia						
7	Achin	Dominic	stove user / manufacturer / distributor / NGO government / Academia			Asamankese			

Page 1 of 2

Ghana Stakeholder Consultation Sign in Sheet

	Surname	Given name	Circle one	Name of NGO, gov agency, or University, if applicable	Position	Postal address	Email address, if available	Phone number	Signature (sign as you leave)
1	Addo	Ahmad (Ar)	stove user / manufacturer / distributor / NGO government / Academia (circled: Academia)	Kwame Nkrumah Univ. of Science & Tech	Senior Lecturer/ Agric Engineer	Dept of Agric Engineering Kumasi	addoahmad@yahoo.com	0244518386	[signature]
2	Adongo	Baba	stove user / manufacturer / distributor / NGO government / Academia (circled: NGO)	TechnoServe	Ops manager	TechnoServe Ghana	badongo@tnsgh.org	0244615857	[signature]
3	Acolatse	Shika	stove user / manufacturer / distributor / NGO government / Academia (circled: NGO)	TechnoServe	Project Manager	P.O. Box 135 Accra	[illegible]@tnsgh.org	0244623772	[signature]
4	Djokoto	Fred	stove user / manufacturer / distributor / NGO government / Academia (circled: Academia)	Inst of Ind. Res CSIR	Research Officer	P.O. Box M32 Accra	fdjokoto@yahoo.com	020-8219520	[signature]
5	Kotey	Frederick	stove user / manufacturer / distributor / NGO government / Academia (circled: Academia)	CSIR - Institute of Industrial Research	Research officer	P.O. Box LG 576 Legon	[illegible]@yahoo.com	0208726658	[signature]
6	Sedu	Ibrahim	stove user / manufacturer / distributor / NGO government / Academia (circled: stove user)	—	—	P.O. Box 63 Asamankese	—	—	[signature]
7	Awoako	Ilwasi	stove user / manufacturer / distributor / NGO government / Academia (circled: manufacturer / distributor)	—	—	Achiase E/R	—	—	
8	Togobo	Wisdom	stove user / manufacturer / distributor / NGO government / Academia (circled: government)	Min of Energy	Head Renewable	Box T40 Stadium PO Accra	wtogobo@yahoo.com	0244259407	[signature]
9	Appiah	Frederick Ken.	stove user / manufacturer / distributor / NGO government / Academia (circled: government)	Energy Commission	RE Prog. Officer	PMB Ministries PO Accra	fred.ken.appiah@gmail.com	0244872473	[signature]
10	Quarcoo	Raymond	stove user / manufacturer / distributor / NGO government / Academia (circled: manufacturer)	Assamfuase	Stove Manufacturer	[illegible] Sowdunya		0206715854	
11	Fosu	Eros Kwame	stove user / manufacturer / distributor / NGO government / Academia (circled: manufacturer / distributor)	Labosu	Stove manufacturer	P.O Box 93 Suhum			
12		~~Ay~~	stove user / ~~manufacturer / distributor~~ / ~~NGO government~~ / Academia	~~Togola~~	~~stove manuf~~			0276933392	
13	Mensah	Jeffrey John	stove user / manufacturer / distributor / NGO government / Academia	Togola	stove manuf				
14	Mills	Agyemang	stove user / manufacturer / distributor / NGO government / Academia	Togola	stove manuf	P.O. Box 93 Suhum			

Ghana stakeholder consultation sign in sheet

	Surname	Given name	Circle one	Name of NGO, gov agency, or University, if applicable	Position	Postal address	Email address, if available	Phone number	Signature (sign as you leave)
15	John	Enyan	stove user / manufacturer / distributor / NGO government / Academia	Toyola					
16	Stephen	Azenyu	stove user / manufacturer / distributor / NGO government / Academia	Toyola					
17	Samuel	Agye	stove user / manufacturer / distributor / NGO government / Academia	Toyola					
18	Darkwa	Richard	stove user / manufacturer / distributor / NGO government / Academia						
19	Tomasor ~~[illegible]~~	Charles ~~Charles~~	stove user / manufacturer / distributor / NGO government / Academia	Toyola	Producer			0266627908	
20	Gordon	Mensah	stove user / manufacturer / distributor / NGO government / Academia	Toyola	producer			024372441/2	
21	Kwesi	Veronica	stove user / manufacturer / distributor / NGO government / Academia	Self employed	Trader				
22	Ekow	John	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove manuf			0285249007	
23	Idan	Eric	stove user / manufacturer / distributor / NGO government / Academia	Toyola	Driver			0207146660	
24	Acheampong	Michael	stove user / manufacturer / distributor / NGO government / Academia	Toyola	Driver			0249322003	
25	Ohene	Fred	stove user / manufacturer / distributor / NGO government / Academia	Royal Restaurant	chef			0249617088	
26	Isaka	Adamu	stove user / manufacturer / distributor / NGO government / Academia	Royal Restaurant	Manager			0249617084	
27	Jorla	Simon	stove user / manufacturer / distributor / NGO government / Academia	Toyola	motor rider and sales man			0207997148	[signature]
28	Lucky	Dople	stove user / manufacturer / distributor / NGO government / Academia	Toyola	mason			027628265	

Ghana stakeholder consultation sign in sheet

	Surname	Given name	Circle one	Name of NGO, gov agency, or University, if applicable	Position	Postal address	Email address, if available	Phone number	Signature (sign as you leave)
29	Owusu	Eric	stove user / manufacturer / distributor / NGO government / Academia						
30	Tamakloe	Ebenezer	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove manuf			0244938145	
31	Nartei	Joseph	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove distributor			0272173532	
32	Tei-Korko	Sarah	stove user / manufacturer / distributor / NGO government / Academia	[illegible]	stove distributor			0274010752	
33	Maku [illegible]	Faustina	stove user / manufacturer / distributor / NGO government / Academia					0274010752	
34	Akoto	Samuel	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove distributor				
35			stove user / manufacturer / distributor / NGO government / Academia						
36	Lartey	Regina	stove user / manufacturer / distributor / NGO government / Academia		Tracter			0244-114721	
37	Amuzu	Phelomina	stove user / manufacturer / distributor / NGO government / Academia	Toyola	Supplier			024503 8190	
38	Afriyie	Janet	stove user / manufacturer / distributor / NGO government / Academia		Seamstress			024687 1741	
39	LARTEY	RICHARD	stove user / manufacturer / distributor / NGO government / Academia	RICHARD STORE	TRADER	L.D.S. Box 2555 TESANO [illegible] ACCRA		0277292146	
40	Danso	Frank	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove distributor	H/no D21C Asamankese Freetown.		0266633693	
41	Larbi	Daniel	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove manuf			0245026262	
42	Lartey	Godfred	stove user / manufacturer / distributor / NGO government / Academia	Toyola	stove manuf	L.D.S Box 2555 Tesano ward Accra		0277292146	

Ghana stakeholder consultation sign in sheet

	Surname	Given name	Circle one	Name of NGO, gov agency, or University, if applicable	Position	Postal address	Email address, if available	Phone number	Signature (sign as you leave)
50	Botokuna	Kwame Anthwi	stove user manufacturer / distributor NGO government Academia	Toyola	stove manuf			0272290738	
51	Osei	Kojo	stove user manufacturer / distributor NGO government Academia	Toyola	stove manuf			0270890734	
52	KWAME	KOFI	stove user manufacturer / distributor NGO government Academia	Toyola [illegible]	stove manuf			0242942[illegible]	
53	Obuyor	Richard	stove user manufacturer / distributor NGO government Academia	JUAPRHS (NGO)	centre official			0272278407	
54	Agbegnega	Joseph	stove user manufacturer / distributor NGO government Academia	Toyola	stove manuf				
55	Nutsuga	Selasi	stove user manufacturer / distributor NGO government Academia	Toyola	stove manuf			0244083872	
56	Siaa	Kwaku	stove user manufacturer / distributor NGO government Academia	Toyola	stove manuf			0274468133	
57	Asamoah	Joe	stove user manufacturer / distributor NGO government Academia	Regent University	Dean	P.O. Box DS 1434 Dansoman	jasa2@yahoo.com	024 234 1022	[signature]
58	Kobbo A	Ebenezer	stove user manufacturer / distributor NGO government Academia	Amerdane Ebenezer		Sapehman			
59	Agyei	Stephen	stove user manufacturer / distributor NGO government Academia	Abuni garden		P.O. Box 93 Asafo		0244087852 [illegible]	[signature]
60	Addae	[illegible]	stove user manufacturer / distributor NGO government Academia	[illegible]			[illegible]	0249936 27	[signature]
61	Akonor	Emmanuel	stove user manufacturer / distributor NGO government Academia		Shop owner	Akuri Garden		0276254060	
62			stove user manufacturer / distributor NGO government Academia						
63			stove user manufacturer / distributor NGO government Academia						

Virtual stakeholder consultation

Since not all invitees attended the event in person, invited guests were given the opportunity to comment on the project design virtually via email. The project summary was distributed (with incorporated edits based on input from the stakeholder consultation), in addition to Gold Standard's stakeholder consultation questionnaire. However, no additional comments were received via this forum. The following 22 stakeholders were invited to comment on the project design after the in person consultation took place:

Last name	First name	Organization	Email address
Agyemang-Bonsu	William	Ministry of Energy – Ghana DNA	agyemang_bonsu@yahoo.co.uk
Abavana	Clement	Ministry of Energy	cabavana@energymin.gov.gh, abavana@ghana.com
Sasu	Oppon	Forestry Commission	sasuoppon@yahoo.com
Harriette	Amissah-Arthur	KITE	haarthur@kiteline.net
Edjekumhene	Ishmael	KITE	iedjekumhene@kiteonline.net
Oduro	Theodora	KITE	toduro@kiteonline.net
Hyman	Jasmine	Gold Standard Foundation	jasmine@cdmgoldstandard.org
Tyler	Emily	Gold Standard Foundation - South Africa Expert	emilyt@genesis-analytics.com
Bürer	Meinrad	Gold Standard Foundation	meinrad@cdmgoldstandard.org
Schlup	Michael	Gold Standard Foundation	michael@cdmgoldstandard.org
Brew-Hammond	Abeeku	Kwame Nkrumah University of Science and Technology (KNUST)	abeeku@brewhammond.com
Coche	Laurent	UNDP Regional Programme	laurent.coche@undp.org
OUALY	Aboubacar	PNUD	bouba.oualy@ptfm.net
Duah-Yentumi	Stephen	UNDP Ghana	stephen.duah-yentumi@undp.org
King	Rudith	Centre for Settlements Studies, College of Architecture and Planning Kwame Nkrumah University of Science and Technology (KNUST) Kumasi, Ghana	rudithk@yahoo.com
Furusawa	Tomoki	UNDP Ghana	tomoko.furusawa@undp.org
O-Donnel	Karen	USAID Ghana	ko'donnell@usaid.gov
Hellyer	Robert	USAID Ghana	rhellyer@usaid.gov
Diwan	Ishac	World Bank Ghana	Idiwan@worldbank.org
Maisterra	Pilar	World Bank Ghana, based in DC	Pmaisterra@worldbank.org
Diallo-Bah	Asmaou	World Bank Ghana	Adiallobah@worldbank.org
Dennis	Regina	USAID Ghana	Rdennis@usaid.gov

Stakeholder Invitation List (not including some local invitees)

Last name	First name	Organization	Email address
Agyemang-Bonsu	William	Ministry of Energy	agyemang_bonsu@yahoo.co.uk
Ahiataku-Togobo	Wisdom	Ministry of Energy	wtogobo@yahoo.co.uk
Abavana	Clement	Ministry of Energy	cabavana@energymin.gov.gh, abavana@ghana.com
Sasu	Oppon	Forestry Commission	osasu@fsd.fcghana.com, sasuoppon@yahoo.com
Harriette	Amissah-Arthur	KITE	haarthur@kiteline.net, harriette@amissaharthur.com
Edjekumhene	Ishmael	KITE	iedjekumhene@kiteonline.net
Oduro	Theodora	KITE	toduro@kiteonline.net
Hyman	Jasmine	Gold Standard Foundation	jasmine@cdmgoldstandard.org
Tyler	Emily	Gold Standard Foundation - South Africa Expert	emilyt@genesis-analytics.com
Bürer	Meinrad	Gold Standard Foundation	meinrad@cdmgoldstandard.org
Schlup	Michael	Gold Standard Foundation	michael@cdmgoldstandard.org
Asamoah	Joe	Independent consultant	joasa2@yahoo.com
Brew-Hammond	Abeeku	Kwame Nkrumah University of Science and Technology (KNUST)	abeeku@brewhammond.com
Addo	Ahmad	Senior Lecturer Agricultural Engineering Department Kwame Nkrumah University of Science and Technology	addoahmad@yahoo.com
Coche	Laurent	UNDP Regional Programme	laurent.coche@undp.org
OUALY	Aboubacar	PNUD	bouba.oualy@ptfm.net
Duah-Yentumi	Stephen	UNDP Ghana	stephen.duah-yentumi@undp.org
King	Rudith	Centre for Settlements Studies, College of Architecture and Planning Kwame Nkrumah University of Science and Technology (KNUST) Kumasi, Ghana	rudithk@yahoo.com
Furusawa	Tomoki	UNDP Ghana	tomoko.furusawa@undp.org
O-Donnel	Karen	USAID Ghana	ko'donnell@usaid.gov

Hellyer	Robert	USAID Ghana	rhellyer@usaid.gov
Diwan	Ishac	World Bank Ghana	Idiwan@worldbank.org
Maisterra	Pilar	World Bank Ghana, based in DC	Pmaisterra@worldbank.org
Diallo-Bah	Asmaou	World Bank Ghana	Adiallobah@worldbank.org
Railston-Brown	Nick	Technoserve Ghana	nickrb@tnsgh.org
Adongo	Baba	Technoserve Ghana	badongo@tnsgh.org
Dolan	Larry	USAID Ghana	Ldolan@usaid.gov
Dennis	Regina	USAID Ghana	Rdennis@usaid.gov

Non-technical summary

The following non-technical summary (with one edit based on stakeholder input from participants at the meeting) was distributed prior to and during the stakeholder consultation:

Project Summary:
Improved Household Charcoal Stoves in Ghana

Developed by E+Carbon and Toyola Energy Limited according to the Gold Standard's
"Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes, Version 1"

E+Co ENERGY THROUGH ENTERPRISE — The Gold Standard Premium quality carbon credits — Toyola Energy Ltd

Overview:

This project will reduce greenhouse emissions by disseminating fuel-efficient charcoal stoves throughout Ghana. An overwhelming majority of households in Ghana cook using inefficient stoves that are fueled by charcoal. These inefficient stoves emit pollution that threatens human health and the environment, and their high charcoal requirement worsens deforestation. This new stove project will use carbon finance to help large populations shift away from using inefficient stoves and towards more efficient stoves that will protect public health and the environment. Revenues from the sale of carbon offsets will be used to lower the stoves' retail price, while introducing quality guarantees, an ongoing monitoring and evaluation component and other business development services that ensure improved access to efficient stoves for a broader cross section of Ghanaian households and businesses.

Background:

Fuelwood and charcoal meet approximately 75% of Ghana's fuel requirements[64]. Approximately 69% of all urban households in Ghana use charcoal[65]. The annual per capita consumption is approximately 180 kg; the total annual consumption is about 700,000 tones. Accra and Kumasi, the two largest cities in Ghana, account for 57% of the charcoal consumed in country[66].

Currently, inefficient and polluting cooking regimes are deeply entrenched in Ghanaian culture. The over-dependence by most of the population on charcoal and fuelwood as energy sources has heightened the threat of deforestation and desertification in many parts of the country[67]. As the sources in the forest and savannah belt become depleted, other parts of the country will likely become sources for charcoal.

Project Details:

Carbon finance provides a means to increase affordability of stoves by lowering their retail price while introducing quality guarantees, an ongoing monitoring and evaluation component and other business development services that ensures improved access to efficient stoves. E+Carbon is working closely with a local manufacturing and distribution company called Toyola Energy Limited (TEL) to implement this project. TEL was established in 2003. It is owned and managed by highly educated and trained entrepreneurs. TEL was part of 50 informal metal artisans selected and trained by Enterprise Works[68] to fabricate the "GYAPA" charcoal efficient cook stoves.

The project promotes sales of improved charcoal stoves in urban, peri-urban and rural communities in Ghana. TEL's distribution network is expanding to cover major towns and market centers in and around the Greater Accra Region, Eastern Region, Ashanti Region and Central Region.

As part of the carbon finance contracts between E+Carbon and TEL, TEL guarantees to reinvest 100% of its share of carbon revenues in efforts that discourage unsustainable biomass consumption and mitigate adverse health effects from indoor air pollution in Ghana. E+Carbon and TEL recognize that efficient charcoal stoves are a medium term solution, and future plans could include using carbon revenues to promote the production of green charcoal as a way to make cooking in Ghana more sustainable.

TEL's improved charcoal stove reduces fuel consumption by introducing a ceramic liner that increases combustion efficiency and retains heat. The stove consists of hourglass shaped metal cladding with perforated interior ceramic liner that allows ash to fall to the collection chamber at the base. A thin layer of cement is placed between the cladding and the liner to

[64] http://www.fao.org/countryprofiles/index.asp?lang=en&iso3=GHA&subj=5

[65] FASO Ghana report

[66] source 06 07 05 ECo Investment Rec Toyola_964_2.doc (find actual site)

[67] Atakora, S. Biomass Technologies in Ghana. Kumasi Institute of Technology and Environment (KITE). Accessed at: http://www.nrbp.org/papers/046.pdf

[68] Enterprise Works Worldwide is a global NGO that fights poverty through business development and market awareness programmes.

bind the two. During use, a single pot rests at the top of the stove. A 2002 study[69] conducted in Ghana found that a stove of similar design was 37% more fuel-efficient than traditional methods[70], though a ceramic liner has the potential to improve fuel-efficiency by up to 50%[71].

Gold Standard Sustainability Analysis:

This project is being developed according to the Gold Standard, which is a standardized protocol for developing carbon offsets that is considered the highest benchmark for quality assurance. To ensure that Gold Standard projects promote sustainable development, the protocol requires that project developers conduct a sustainability analysis that assesses the project in terms of environmental and sustainable development impact. The following is a completed summary of Gold Standard's relevant indicators:

1. Mothers and children will be exposed to fewer hazardous air pollutants through reduced emissions of carbon monoxide and fine particulate matter. Air pollution from cooking with solid fuel is a key risk factor for childhood acute lower respiratory infections (for example, pneumonia) as well as many other respiratory, cardiovascular, and ocular diseases. In Ghana, exposure to indoor air pollution (commonly measured by the pollutants carbon monoxide and fine particles) is responsible for the loss of 502,000 disability-adjusted life-years (DALY)[72]. The DALY is a standard metric used by the World Health Organization (WHO) to indicate the burden of death and illness due to a specific risk factor. The WHO also estimates that exposure to indoor air pollution is responsible for 16,600 deaths per year in Ghana.

2. Biodiversity will be improved through the stove program by reducing pressure on remaining forest reserves. Initial field estimates and secondary sources suggest that 61% of charcoal in Ghana is produced from non-renewable sources. However, primary field data is currently being collected to determine exact figures as part of a charcoal non-renewability assessment.

3. The improved stoves give rise to employment opportunities for TEL and its affiliates who are manufacturing, distributing, retailing, and maintaining the stoves (though this may be offset by reduced employment for charcoal makers and sellers).

4. Livelihoods will be improved since the efficient stoves reduce fuel costs. On average, a household stove user saves between US$30 and US$35 per year for an initial investment of US$6-10 for a stove (the payback period is generally 2 – 3 months per stove). This does not include a potential decrease in price as a result of carbon revenues.

5. Urban householders will have improved access to energy (37-58% more effect from the same fuel).

[69] Stosch, Lisa and Wilhemina Quaye, *A Study of Fuel Consumption in Three Types of Household Charcoal Stoves in Ghana*. Accra, Ghana. December, 2002

[70] http://www.shellfoundation.org/index.php?newsID=372

[71] http://www.shellfoundation.org/index.php?newsID=419

[72] World Health Organization, December 2004, at http://www.who.int/healthinfo/bod/en/index.html.

6. Human capacity is raised through the business development component of the project.

7. The introduction of locally manufactured technology with optimized energy efficiency helps to build technological self-reliance.

Questions or comments

An in person stakeholder consultation, where E+Carbon outlined the project in detail, will be held on Friday, 4 July, 2008 at 10:30am at the Aburi Botanical Gardens, located at Aburi in the Eastern Region in Ghana. We invite you to attend or comment virtually on the project design via email. Kindly send any comments to Erik Wurster, Carbon Finance Officer for E+Carbon, at erik.wurster@eandco.net.

Annex 6:
Baseline Monitoring Report

The baseline monitoring report was prepared by Berkeley Air Monitoring Group and begins on the next page for purposes of preserving document format.

BERKELEY AIR
MONITORING GROUP

2124 KITTREDGE STREET #57, BERKELEY, CA 94704

Carbon Monitoring Report on the Improved Charcoal Stove of Toyola Energy Limited, Ghana

for

E+Carbon

prepared by:

Berkeley Air Monitoring Group

August 2008

I. Methods and Approach

I.A. Kitchen Survey

The majority of Toyola's current charcoal stove sales occur in the Greater Accra Region (35%) and the Eastern Region (43%). Kitchen Surveys were therefore administered on customers within those two regions. As Toyola is beginning to market stoves to other regions of the country, namely Ashanti, Central, and Northern regions, on-going Kitchen Surveys will be performed in these areas.

125 Kitchen Surveys were collected in total by a field team of three plus one supervisor in May 2008. The Kitchen Survey households were chosen from Toyola's sales record using clustered random sampling inside of the two regions of Ghana. The sales records were used, along with input from Toyola's local sales representatives, to target areas with high concentrations of sales of the stove. These areas were representative of and demographically similar to Toyola's typical Greater Accra and Eastern Region customers. The breakdown of the Kitchen Surveys by region and village is shown below:

- 75 surveys in the Eastern Region; Villages: Ayikuma, Nsawam, Koforidua, Akuapem North, Kitase, Obosomase, and Abun Kitase
- 50 surveys in the Greater Accra Region; Villages: Dangbe West, Agrama, Pokuase, Greater Accra West, and Amansama

I.B. Kitchen Performance Test

Kitchen Performance Tests (KPTs) were performed in 54 households (HHs) in Ghana's Eastern Region by a field team of three and a supervisor in May-June 2008. The KPT was conducted over three full days, requiring daily household visits for four days. Charcoal and, where applicable, fuelwood, were weighed daily using Accu-Weigh spring scales. A KPT survey was also administered daily to record information about cooking stove and fuel usage, the number and type of meals prepared, and the number of people cooked for. Additionally, the full Kitchen Survey was also administered to these 54 households. The KPT was performed using a "Before and After" (paired) study design. The KPT was performed in the households "Before" the introduction of the efficient charcoal stove (traditional charcoal stove phase), the efficient stove was then introduced, the HHs were then given several days to become accustomed to the efficient stove, and finally the "After" KPT was performed.

The KPT households were selected using screening criteria based on the 125 Kitchen Surveys, so as to be representative of the typical efficient stove customer. The 54 KPT households came from the Eastern Region of Ghana. The breakdown of the 54 KPT households by village is shown below:

- 18 KPTs in Ayikuma village
- 18 KPTs in New Dodowa village
- 18 KPTs in Old Dodowa village

The Kitchen Surveys revealed that about 30% of efficient stove purchasers also cooked daily with fuelwood; this percentage was generally confirmed by local knowledge of the efficient stove customers. Hence, the screening criteria were used to include both HHs who were not fuelwood users and HHs who were daily fuelwood users. In the end, the KPT included 36 HHs who did not use fuelwood and 18 HHs who used fuelwood daily.

Toyola's sales record of 1613 efficient charcoal stoves sold in 2007-8 was analyzed to determine the percentage of sales by region and by stove type (for each of the four stove types). The household medium stove accounted for 96.9% of the sales, the household small accounted for 2.4%, and the small and large commercial stoves combined to make up 0.7%. Given this distribution of sales, only the household medium stove was used in the KPT, while adjustment factors were determined for the other stove types to account for the larger and smaller stoves. Sales by region were as follows: 60% in Eastern Region, 38% in Greater Accra, and 2% in Ashanti.

I.C. Non-renewable Biomass Baseline Study

Non-renewable biomass baseline (NRBB) research is typically performed via desk research combined with visits to local experts in forestry and energy. Interviews and site visits held in-country generate the data used in the quantitative determination of the percent non-renewability in the area.

Between June 13 and June 22, 2008 the Berkeley Air field team conducted non-renewable biomass baseline (NRBB) research on the fuel supply basin in Ghana. In particular, this research was performed to determine to what extent the project population's use of woody biomass for charcoal is not balanced by re-growth in the supply area.

<u>Interviews Held</u>

- Forestry Commission - Tema Regional Office
- Forestry Commission - Amasaman Regional Office
- Forestry Commission – Accra Headquarters
- United Nations Development Program (UNDP)
- Ministry of Energy (Renewable Energy Unit)
- Achimota Charcoal Transport Cooperative

<u>Documents Consulted</u>

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- UNDP, "Main Cooking Fuel by Households in Ghana 2000, 2000 Population & Housing Census", Ghana Statistical Service, 2005

Quantitative Approach

The quantitative approach for calculating X_{nrb} (non-renewability fraction) requires defining the fuel supply area, mean annual increment, and annual harvest for the Project Area.

Fuel supply area (A):

The fuel supply area for the Greater Accra and Eastern regions includes forest stands and savannah across the country, primarily the Afram Plains, Brong Ahafo, Volta, and the Eastern and Central Regions.

Mean annual increment (MAI):

MAI is the annual amount of biomass regrowth within the supply area, either from natural vegetative growth or replantings. Although the MAI would ideally be calculated for the biomass used for charcoal production only or for all woodfuel (charcoal plus fuelwood) only, the growth and harvesting of woodfuel cannot be separated from the growth and harvesting of all wood for all purposes. Consequently, we focused on the MAI for all wood, not just woodfuel.

Annual harvest (H):

H is the total annual amount of biomass removed from the supply area. While we can define H for charcoal, in order to accurately compare H to MAI, we must use figures for all wood harvested for all purposes.

Given the above, the non-renewability fraction is calculated as:

$$X_{nrb} = 1 - (MAI/H)$$

II. Results

II.A. Kitchen Survey

Among the 125 Kitchen Survey respondents (who had already purchased an improved charcoal stove), the number of people being cooked for is shown in Figure 1 below. The figure shows the distribution of the 75 respondents from the Eastern Region and the 50 respondents from Greater Accra. The distributions for each region were very similar. The nine responses greater than 14 were for households that included commercial cooking.

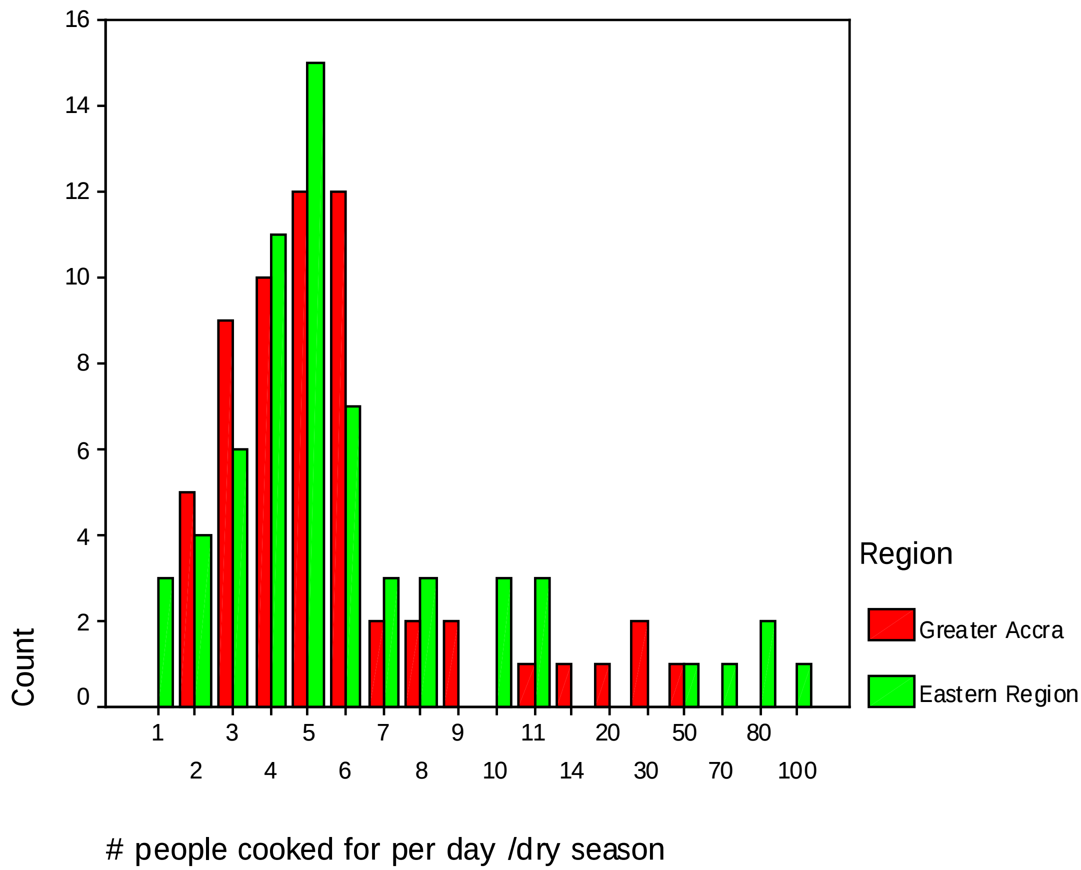

Figure 1. Kitchen Survey responses for the number of people being cooked for, in Greater Accra and Eastern Region.

The data in Figure 1 was used to create criteria for the KPT household selection process. In order to cover the typical range of people being cooked for and to avoid the outliers, households cooking for between 2 and 11 people were included in the KPT. Households cooking for very large numbers (greater than 11) were excluded from the KPT so as to be conservative with overall fuel savings estimates. This exclusion criterion essentially excluded the less common situation of commercial cooking.

The survey results on fuel use other than charcoal are shown in Table 1 below.

Table 1. Survey results on the number of households using fuels other than charcoal at least once per day, before the purchase of the efficient stove.

	Before Improved Stove (HHs with 1 or more uses per day)
Fuelwood	38 of 125 (30%)
LP Gas	16 of 125 (13%)
Kerosene	2 of 125 (2%)

Table 1 shows that 30% of efficient stove customers reported cooking with fuelwood at least once per day before they purchased their improved stove. This data led to the KPT household selection criterion that approximately 30% of the households should be daily fuelwood users. Table 1 also shows that few efficient stove users cooked with fuels other than charcoal and fuelwood daily.

The kitchen survey did not reveal any relevant differences in the dry and rainy seasons regarding the number of people cooked for, the number of meals cooked per day, the frequency of use of fuels other than charcoal, and the types of foods cooked.

The kitchen survey did not reveal any significant differences in the Eastern Region and Greater Accra. The similarity in the number of people cooked for was shown in Figure 1 above. Additionally, the households' highest level of education and main source of income were quite similar in each region, as shown in Figures 2 and 3 below.

Overall, the Kitchen Survey identified one potential clustering criterion for estimating the fuel savings of efficient stove users: that of daily use or non-use of fuelwood.

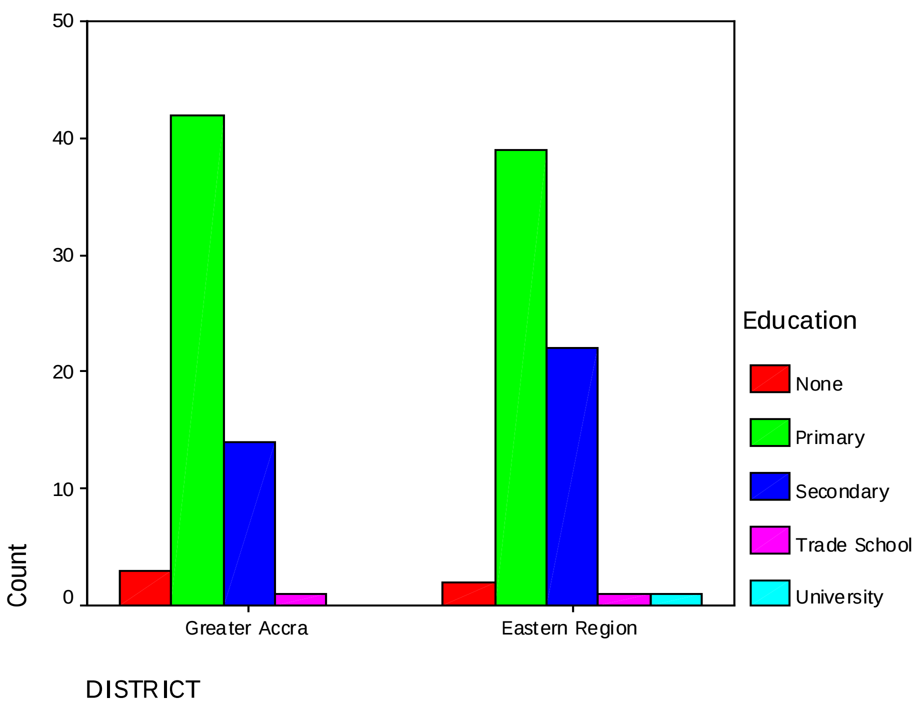

Figure 2. Kitchen Survey responses for the highest level of education, in Greater Accra and Eastern Region.

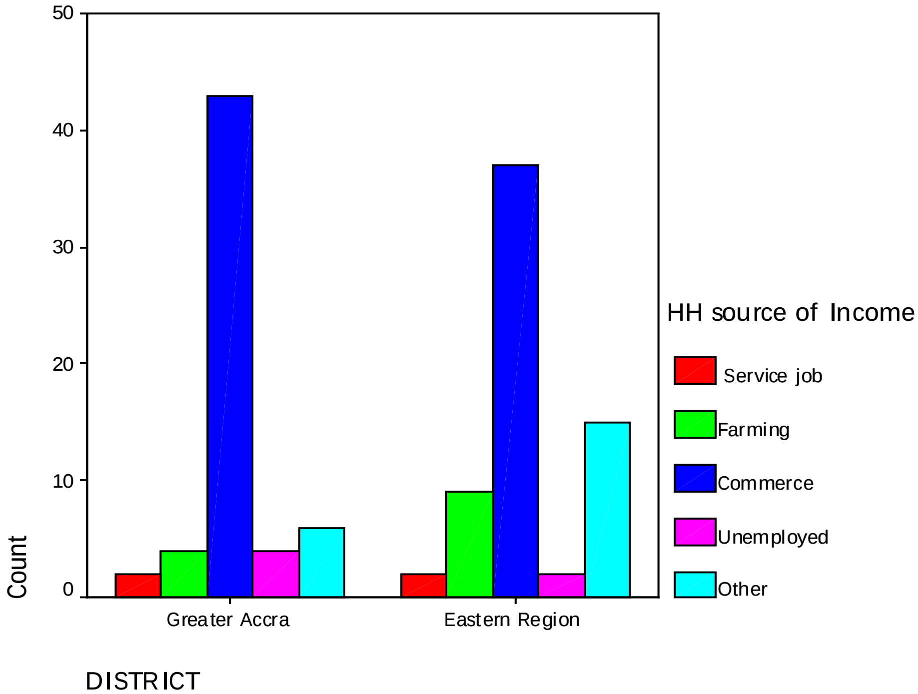

Figure 3. Kitchen Survey responses for the households' main source of income, in Greater Accra and Eastern Region.

II.B. Kitchen Performance Test

Measured Charcoal Savings Results

Table 2 below summarizes the charcoal use results of the 3-day KPT before and after purchase of an improved stove, in units of kilograms per household-day (kg/HH-day). The charcoal savings (Before – After) are also shown, along with the p-value of a paired, two-sided t-Test for significance. Results for all 54 households and each of the two sub-groups are shown.

Table 2. Daily charcoal use results of the kitchen performance test in kilograms per household per day (kg/HH-day). The standard deviations are shown in parentheses.

Sub-group	***# of HHs***	***Charcoal Use Before Improved Stove***	***Charcoal Use After Improved Stove***	***Charcoal savings, Before–After***	***t-Test***
		(kg/HH-day)	***(kg/HH-day)***	***(kg/HH-day)***	***(p value)***
All households	54	1.5 (0.8)	1.0 (0.4)	0.50 (0.8)	0.00005
No fuelwood HHs	36	1.5 (0.7)	1.1 (0.4)	0.42 (0.7)	0.0008
Daily fuelwood HHs	18	1.4 (1.0)	0.9 (0.3)	0.54 (0.9)	0.02

As the t-Test p-values in Table 2 above reveal, all groups had significant charcoal savings. There was, however, no statistical difference in the charcoal savings in the '*No fuelwood*' and '*Daily fuelwood*' sub-groups; the p-value of the t-Test comparing the two sub-groups was 0.7.

Additionally, the charcoal savings per person-day for all 54 HHs was 0.090 kg. Again, there was no difference in charcoal savings per person-day between the two sub-groups: 0.087 kg for '*No fuelwood*' and 0.10 kg for '*Daily fuelwood*' sub-groups ($p = 0.8$).

Therefore, the use, or non-use, of fuelwood was not considered a valid clustering criterion, as it had so little effect on the measured charcoal savings. As shown in Table 2, the average charcoal savings for all households was 0.5 kg/HH-day.

Thus, we have greater than or equal to 90% confidence that charcoal savings exist based on the sample size used and the analysis performed.

Observers will note the significant difference in standard deviations between the Before and After measurements. This is true for two reasons. First, there is more variability among Before measurements simply because Before measurements are performed prior to introduction of the Toyola Coalpot stove. After the stove is introduced, there will be less variability among users because they all are using the same stove. Furthermore, the variability is measured by dividing the standard deviation by the mean, not by simply looking at the standard deviation. Since the means in the Before group are larger, once "normalized," the variability between the Before and After groups are much closer than the standard deviations might suggest.

We also note the fact that standard deviation exceeds mean fuel savings in all cases. There is no statistical reason why the standard deviation (of the set of Before minus After values) cannot be greater than the mean. As noted earlier, the percent variability (which is equal to the standard deviation divided by the mean; also known as the coefficient of variation, COV) of the set of differences (Before - After) is greater than the percent variability of either set of Before or After measures -- and this is typical. Furthermore, the t-Tests take into account the variability. So, if one wants to know whether the After values are significantly lower than the Before values, one wouldn't be concerned that the variability (in Before - After values) is greater than the mean, one should just look at the t-Test p value.

Charcoal Use Adjustment Factors

The Kitchen Survey results pointed to one potential clustering criterion, that of daily fuelwood use or non-use. The KPT revealed, however, that there was no difference in charcoal savings between these two sub-groups.

Additionally, there was no relationship between average charcoal savings per household-day and household size ($r^2 = 0.0005$), as shown in Figure 4 below.

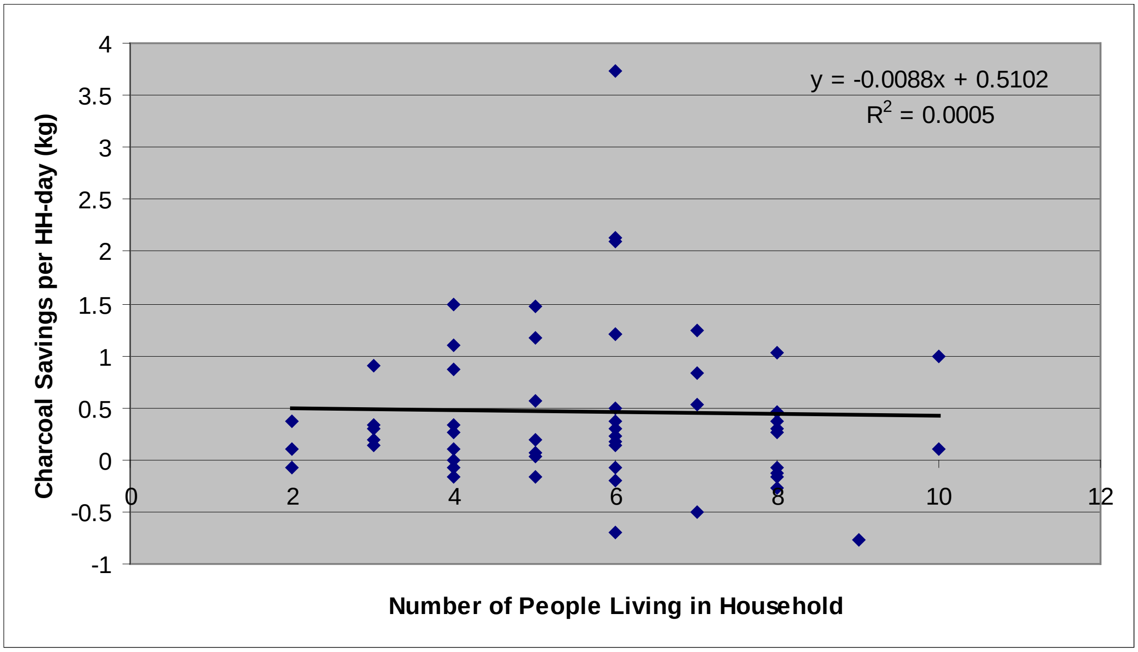

Figure 4. Average charcoal savings per household-day versus household size.

No other clusters were revealed by the Kitchen Survey or by the analyses of the KPT results.

Although the other three stove models only make up a small percentage of stove sales (less than 5%), it is necessary to determine a fuel savings conversion factor that can be applied to charcoal savings for future monitoring and verification work. These adjustment factors can be used to adjust the figures in Table 2 to calculate the emissions savings from charcoal of TEL's full range of stoves.

As such, we estimate the relative charcoal savings potential ratios based on similar adjustment factors determined for different stove emissions reduction projects in the region. That is, we can assign accurate conversation factors based on the size difference between the KPT stove and these other sizes, and other similar tests across different size stoves in the region and with similar stove designs. Prior calculations from both Uganda and Mali suggest that the adjustment factors below will offer a conservative estimate of emissions reductions for the other three stove sizes.

Table 3. Adjustment factors for fuel savings (charcoal) of all four TEL stove types.

Stove Type	***Adjustment Factor***
Large commercial	Medium household * 1.4
Small commercial	Medium household * 1.2
Medium household	1.0 (Measured in KPT)
Small household	Medium household * 0.5

While the large and small commercial stoves currently[73] represent less than 2% of total sales, the small household stove, which represents a slightly larger proportion, has been deeply discounted to be certain that the projection made is conservative. Although the diameter of the small household stove is only 18% smaller than the Medium Household on which the KPT was performed, the emission reductions from the Small Household stove have been reduced by 50% compared to the Medium Household.

Fuelwood Savings Results

Along with charcoal use, fuelwood use was measured in all daily fuelwood-using households. The results are shown in Table 4 below.

Table 4. Daily fuelwood use results of the kitchen performance test in kg per household per day. The standard deviations are shown in parentheses.

Sub-group	***# of HHs***	***Fuelwood Use Before Improved Stove***	***Fuelwood Use After Improved Stove***	***Fuel wood savings (Before–After)***	***t-Test***
		(kg/HH-day)	***(kg/HH-day)***	***(kg/HH-day)***	***(p value)***
Daily fuelwood HHs	18	3.6 (1.8)	2.9 (1.5)	0.73 (1.6)	0.07

Average fuelwood savings were 0.73 kg/HH-day, with a nearly significant p value of 0.07.

Therefore, we have greater than or equal to 90% confidence that fuelwood savings exist based on the sample size used and the analysis performed.

Fuelwood savings adjustment factors

The Kitchen Surveys revealed that about 30% of efficient stove purchasers also cooked daily with fuelwood; this percentage was generally confirmed by local knowledge of the efficient stove customers. Thus, an adjustment of 0.30 was applied:

0.73 kg/HH-day * 0.30 = 0.2 kg/HH-day (adjusted daily fuelwood savings)

The daily fuelwood savings will be applied to medium household, small commercial and large commercial stoves without any adjustments in spite of their larger size, but in order to be conservative, will not be applied to small household stove. The adjustment factors for daily fuelwood savings for each stove type are summarized in Table 5 below.

Table 5. Adjustment factor for daily fuelwood savings for each stove type.

Stove Type	***Adjustment Factor***
Large commercial	1.0
Small commercial	1.0
Medium household	1.0
Small household	0

[73] As of July 15, 2009

So in fact, these are not adjustment factors per se. We have simply assumed that larger stoves than the Medium Household stove will save at least as much fuelwood in a household, and no adjustments have been made to account for larger stoves. We then completely omitted any fuelwood savings from the smaller stove. Based on our experience, we find this to be a highly conservative approach to estimating fuelwood savings.

Final Daily Fuel Savings

The final daily charcoal and fuelwood savings are shown in Table 6.

Table 6. Daily charcoal and fuelwood savings for each stove type

	Daily Fuel Savings (kg/HH-day)	
	Charcoal	***Fuelwood***
Large commercial	1.4 * 0.5 = **0.7**	**0.2**
Small commercial	1.2 * 0.5 = **0.6**	**0.2**
Medium household	**0.5**	**0.2**
Small household	0.5 * 0.5 = **0.25**	**0**

II.C. Non-renewable Biomass Baseline Study

The wood that meets the fuel needs of the inhabitants of the Greater Accra and Eastern regions is harvested from forest stands and savannah across the country, including specifically: the Afram Plains, Brong Ahafo, Volta, and the Eastern and Central Regions. National, as opposed to supply basin-specific, numbers from the FAO[74] are used in the calculation because there is a dearth of data on the production and harvest of woodfuel within the specific supply basin in which we are interested. As the FAO notes, "[d]espite several past attempts at improving biofuel information systems in Africa, woodfuel information is still very scarce or [of] poor quality."[75] Because the wood that meets the fuel needs of the inhabitants of the Greater Accra and Eastern regions is sourced from a wide range of forest stands and savannah across the country, it is not unreasonable to make a national estimate, particularly when regional information does not exist or is unreliable. Based on our understanding of the forestry sector in Ghana, we expect that the national assessment is more conservative than regionally-specific calculations would be.

Also due to the virtual absence of reliable data on the regionally-specific supply areas, we used a widely accepted, generic value of 2.5% for the mean annual increment (MAI), as first estimated by Openshaw in 1982 (Openshaw, K., An Inventory of Biomass in Kenya: A Conditionally Renewable Resource. 1982, Stockholm, Sweden: Beijer Institute, (Stockholm Environmental Institute)). The FAO recognizes the complexity of estimating woody biomass volume and growth, and concludes that a reasonable approach is to apply the 2.5 percent biomass stocking rate to all formations except forest plantations (FAO, August 2005, "WISDOM East Africa-Spatial woodfuel production and consumption analysis of selected African countries[76].

[74] FAOSTAT-Forestry Database, 2005, http://faostat.fao.org

[75] http://www.fao.org/docrep/009/j8227e/j8227e06.htm#TopOfPage

[76] http://www.fao.org/docrep/009/j8227e/j8227e00.htm

Ghana's total growing stock (S), as defined and calculated by the FAO[77], is 321,000,000 m^3. Multiplying this by a generic mean annual increment rate (r) for wood of 2.5% gives us the total mean annual increment (MAI):

$$MAI = S * r = 321{,}000{,}000\ m^3 * 0.025 = 8{,}025{,}000\ m^3$$

The annual harvest (H) of wood countrywide in 2005[78] was 29,458,000 m^3.

$$X_{nrb} = 1 - (MAI/H) = 1 - (8{,}025{,}000 / 29{,}458{,}000) = 0.73\ (73\%)$$

Thus, the percent non-renewability of woodfuel for Ghana is 73%, to be applied to both charcoal and fuelwood.

Future biomass non-renewability estimates

Over the next several years, potential changes in the non-renewability fractions of charcoal and fuelwood in Ghana will depend on many factors including population growth, forest replanting or continued deforestation, the economy, the affordability of petroleum and electricity, the spread of biomass fuel saving products such as the TEL's efficient stove, and other factors. It is difficult to predict the trend of biomass non-renewability in Ghana. While the efficient stove project will help reduce the pressure on biomass resources, we do not, however, expect this project or others like it to have a highly significant impact on the biomass non-renewability estimates in this report. The 2-year follow-up biomass non-renewability study will capture any significant changes due to the efficient stove project and any others. Additionally, within the next 2 years, more high-quality data may become available, which could improve or further validate the non-renewability estimates in this report.

Sensitivity Analysis

In order to see the effect of variability or error in the parameters used to estimate the non-renewability fraction, a simple sensitivity analysis was performed. As X_{nrb} is equal to 1–(MAI/H), where MAI is equal to the total growing stock (S) times the growth rate (r), S, r, and H are the parameters of interest.

- $X_{nrb} = 0.73$
- A 10% increase in MAI (which is equivalent to a 10% increase in either the total growing stock [S] or the growth rate [r]) would result in an X_{nrb} of 0.70 (a 3.7% decrease)
- A 10% increase in H would result in an X_{nrb} of 0.75 (a 3.4% decrease)

Sense-check

In order to provide a sense-check of the non-renewability fraction calculated for Ghana in this report, Table 7 below illustrates a calculation of non-renewability for several countries in West

[77] 2007 State of the World's Forests, FAO. Annex pg 117. Available for download at http://www.fao.org/docrep/009/a0773e/a0773e00.HTM

[78] 2005 State of the World's Forests Report FAO – Annex 3 pg 282 ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E14.pdf

Africa, using the same methodology and figures provided in 2005 by the FAO country profiles (FAOSTAT-Forestry Database, 2005, http://faostat.fao.org).

Note that established non-renewability fractions are not readily, if at all, accessible for West Africa. As the FAO notes, "[d]espite several past attempts at improving biofuel information systems in Africa, woodfuel information is still very scarce or [of] poor quality, which prevents countries from undertaking detailed diagnosis and relevant planning activities"[79].

Table 7. National biomass non-renewability estimates for West Africa

Country	Growing stock (m^3) (forest + wooded land)	MAI (m^3) (growing stock * 2.5% growth rate)	Annual Wood Harvest (m^3)	X_{nrb}
Burkina Faso	248,000,000	6,200,000	7,338,000	0.16
Cameroon	1,313,000,000	32,825,000	19,772,000	-0.66 (0)
Ghana	321,000,000	8,025,000	29,458,000	0.73
Guinea	520,000,000	13,000,000	14,001,000	0.07
Guinea-Bissau	51,000,000	1,275,000	1,417,000	0.10
Liberia	498,000,000	12,450,000	5,918,000	-1.1 (0)
Mali	443,000,000	11,075,000	6,386,000	-0.73 (0)
Niger	25,000,000	625,000	12,473,000	0.95
Nigeria	1,386,000,000	34,650,000	86,627,000	0.60
Senegal	347,000,000	8,675,000	5,110,000	-0.70 (0)
Western Sahara	38,000,000	950,000	6,332,000	0.85

* MAI calculated from total growing stock (FAO 2005) and a generic 2.5% growth rate

The table shows that NRB varies widely in West Africa. Ghana certainly has one of the higher NRB fractions in the region; although Niger and Western Sahara are higher. It is interesting to note that each of the NRB fractions exist within a particular geographic, social and economic context so that the fraction varies according to the size of existent forest, population, harvesting practices, and the country's position on the so-called energy ladder.

[79] http://www.fao.org/docrep/009/j8227e/j8227e06.htm#TopOfPage

APPENDIX I: Copy of the Kitchen Survey

Survey #: ______

KITCHEN SURVEY: Ghana

Individual Questionnaire

Introductory Remarks:

Good morning /afternoon, my name is ______________________. I am here on behalf of Berkeley Air Monitoring Group, based in the USA. Berkeley Air is an organization dedicated to protecting human health and the climate. I am happy that you have made time for us. We are here today to talk to you about the improved charcoal stove you purchased from Toyola Energy Limited and any other cooking devices that you have in your household. If you would like to participate in the survey, we will ask you to answer some questions. This survey will take about 40 minutes. During this survey, we will ask you about your cooking practices, devices, and fuels. By participating in this survey, you will help us to improve the efficient stoves. All of the information we collect will be kept private. Your name will not appear anywhere. Any other facts that might point to you will not appear when we report the findings of this survey.

** Do you agree to participate? 1. Yes 2. No (**If No, terminate the interview)**

Date of interview: _______________ (format: dd/Mon/yyyy, i.e. 16/May/2008)

Time interview started: ____________ Interviewer's name: ________________________

SECTION A: General Information		
1	NAME:	6. CELL PHONE:
2	HH ID:	7. HOME PHONE:
3	CITY:	8. Purchase date of improved charcoal stove 1:
4	DISTRICT:	9. Purchase date of improved charcoal stove 2 (if any):
5	DOOR NUMBER/STREET NUMBER:	10. Purchase date of improved charcoal stove 3 (if any):

SECTION B: Household Socio-demographic Characteristics		
	QUESTION	**RESPONSE**
11	Sex of the respondent **(Do not ask; check response)**	1. Male 2. Female
12	What is your marital status?	1. Married/Cohabiting 2. Single/Never married 3.Divorced/Separated 4. Widowed
13	What relationship do you have with the head of the household?	1. Wife 2. House Help 3. Daughter 4. Other Relative (*specify*):
14	How many people live in your household (total number)?	Enter number:
15	How many children under 10 years old live in your household?	Enter number:

16	What is your highest level of education attained?	1. None 2. Primary 3. Secondary 4. Trade School 5. University 6. Other *(specify)*: ……..............................….
17	What is your household's main source of income?	1. Service job 2. Farming 3. Commerce 4. Salaried Position (corporate, government) 5. Temporary Employment 6. Unemployed 7. Other (specify):
18	Which of these best describes your household type?	1. Permanent 2. Semi-Permanent 3. Temporary
19	Where is the main cooking place for your household during the **dry season**?	1. Completely outside the house (open air) 2. On the veranda (partially covered) 3. In a separate, enclosed kitchen 4. Inside the main house (enclosed kitchen) 5. Other (specify):
20	Where is the main cooking place for your household during the **rainy season**?	1. Completely outside the house (open air) 2. On the veranda (partially covered) 3. In a separate, enclosed kitchen 4. Inside the main house (enclosed kitchen) 5. Other (specify):
	Section C: Confirm Purchase of Efficient Charcoal Stove	
21	Do you have a efficient charcoal stove?	1. Yes 2.No **(if No, terminate the interview)**
22	For how long have you had the efficient charcoal stove?	Enter length of time:
23	Are you currently using the efficient charcoal stove?	1. Yes 2.No
24	For what type of cooking do you use the efficient charcoal stove?	1. Domestic 2. Commercial 3. Both Domestic & Commercial 4. Institutional (*specify*):
25	Since you bought the efficient stove, do you spend more, less, or the same amount of time cooking?	1. More 2. Less 3. Same (**Skip to Q 28**)
26	How much more or less time do you spend cooking since you bought the efficient stove?	Enter amount:
27	If more or less time, why?	1. It cooks faster/slower 2. Stove uses less/more fuel 3. Stove cooks more/less foods 4. Ceramic liner retains/loses heat 5. Family size decreased/increased 6. Stove doesn't work properly 7. Other (*specify*):
28	Since you bought the efficient stove, do you use more, less, or the same amount of fuel?	1. More 2. Less 3. Same (**Skip to Q 31**)
29	How much more or less fuel do you use since you bought the efficient stove?	Enter amount:
30	If more or less fuel, why?	1. Stove cooks faster/slower 2. Stove is more/less efficient 3. Stove cooks more/less foods 4. Ceramic liner retains/loses heat 5. Family size decreased/increased 6. Stove doesn't work properly 7. Other (*specify*):
31	Do you intend to continue using the efficient charcoal stove?	1. Yes 2. No **(Skip to Q 33)**
32	* If Yes (continuing use), why? (then **Skip to Q 34**)	1. It saves time 2. It saves money 3. It is easy to use 4. It is portable 5. It produces less smoke

		6. Less coughing and eye irritation 7. Other (specify):
33	* If No (not continuing use), why?	1. It is costly 2. It is difficult to use 3. It is not portable 4. It is not convenient 5. It produces more smoke 6. More coughing and eye irritation 7. Other (specify):
34	What can be done to improve the efficient charcoal stove?	Describe:

SECTION F: Cooking Habits

35	How many people do you cook for per day in the **dry season** (on average)?	Enter number:
36	How many people do you cook for per day in the **rainy season** (on average)?	Enter number:
37	How many meals do you cook for your family per day in the **dry season** (on average)?	Enter number:
38	How many meals do you cook for your family per day in the **rainy season** (on average)?	Enter number:

*** BEFORE purchase of efficient charcoal stove ***

Stove type	# of stoves used	# of times used in **dry season**		# of times used in **rainy season**	
		(per day)	(per week)	(per day)	(per week)
Ordinary charcoal stove	39	40	41	42	43
Improved charcoal stove	44	45	46	47	48
3-stone fire (wood)	49	50	51	52	53
Improved wood stove	54	55	56	57	58
Kerosene stove	59	60	61	62	63
Gas (LPG) cooker	64	65	66	67	68
Electricity cooker	69	70	71	72	73
Other stove (*specify*):	74	75	76	77	78

*** AFTER purchase of efficient charcoal stove ***

Stove type	# of stoves used	# of times used in **dry season**		# of times used in **rainy season**	
		(per day)	(per week)	(per day)	(per week)
Ordinary charcoal stove	79	80	81	82	83
Improved charcoal stove	84	85	86	87	88
3-stone fire (wood)	89	90	91	92	93
Improved wood stove	94	95	96	97	98
Kerosene stove	99	100	101	102	103
Gas (LPG) cooker	104	105	106	107	108
Electricity cooker	109	110	111	112	113

Other stove (*specify*):	114	115	116	117	118

* **BEFORE** purchase of efficient charcoal stove *								
Fuel	Amount used *per day* in **dry season**		Amount used *per week* in **dry season**		Amount used *per day* in **rainy season**		Amount used *per week* in **rainy season**	
	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)
Charcoal	119	120	121	122	123	124	125	126
Wood	127	128	129	130	131	132	133	134
Palm residue	135	136	137	138	139	140	141	142
Kerosene	143	144	145	146	147	148	149	150
Gas (LPG)	151	152	153	154	155	156	157	158
Electricity	159	160	161	162	163	164	165	166
Other fuel (*specify*):	167	168	169	170	171	172	173	174

* **AFTER** purchase of efficient charcoal stove *								
Fuel	Amount used *per day* in **dry season**		Amount used *per week* in **dry season**		Amount used *per day* in **rainy season**		Amount used *per week* in **rainy season**	
	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)	(money or time-to-collect)	(bags, tins, or kg)
Charcoal	175	176	177	178	179	180	181	182
Wood	183	184	185	186	187	188	189	190
Palm residue	191	192	193	194	195	196	197	198
Kerosene	199	200	201	202	203	204	205	206
Gas (LPG)	207	208	209	210	211	212	213	214
Electricity	215	216	217	218	219	220	221	222
Other fuel (*specify*):	223	224	225	226	227	228	229	230

Fuel	Foods typically cooked using this fuel (**BEFORE** purchase of improved stove)	Foods typically cooked using this fuel (**AFTER** purchase of improved stove)	Other uses of this fuel in **dry season** (other than cooking & making tea)	Other uses of this fuel in **rainy season** (other than cooking & making tea)
Charcoal	231	232	233	234
Wood	235	236	237	238

Palm residue	239	240	241	242
Kerosene	243	244	245	246
Gas (LPG)	247	248	249	250
Electricity	251	252	253	254
Other fuel (*specify*):	255	256	257	258

Notes/Observations:

Time interview ended: ____________________