

# GS 2514 MONITORING REPORT

1<sup>ST</sup> MONITORING PERIOD: AUGUST 1<sup>ST</sup> 2014 TO JULY 31<sup>ST</sup> 2015

2<sup>ND</sup> MONITORING PERIOD: AUGUST 1<sup>ST</sup> 2015 TO JULY 31<sup>ST</sup> 2016

*(First and last dates of the monitoring period are included)*



## I. Introduction

The monitoring effort was comprised of three different surveys looking with increased precision at the energy usage of the improved cook-stove (Congo Mbote) users:

- The usage surveys was addressed to the largest sample and aimed at establishing the usage rate and the overall satisfaction of the Congo Mbote customers. This survey included people who stopped using their stove.
- The monitoring surveys focused on people who were using their stove and investigated their energy use patterns and the other benefits arising from the usage of the Congo Mbote.
- The Project Field Performance Test is a multiday survey performed on a sub sample of the previous survey during which fuel consumption is actually measured so that emission may be quantified.

The present report synthesizes the results from the above mentioned surveys and from the baseline surveys to give the reader an understanding of the actual climate and socio-economic impact of the project.

The survey dates are as follows –	
Monitoring Survey and Usage survey 2015	3 <sup>rd</sup> June – 10 <sup>th</sup> July 2015
Project field performance tests (KPT) 2015	3 <sup>rd</sup> August – 7 <sup>th</sup> September 2015
Monitoring Survey and Usage survey 2016	6 <sup>th</sup> October - 15 <sup>th</sup> November 2016

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## II. Number of stove included in the project for the first monitoring year

In accordance with the methodology monitoring requirements a project database was maintained with the relevant information for each stove: sale date, place, name of customer, stove serial number, receipt number, size of the stove sold, intended usage (domestic/commercial).

The project database is available in the project supporting documentation. The pie chart below summarize the information derive from the analysis of the project database.

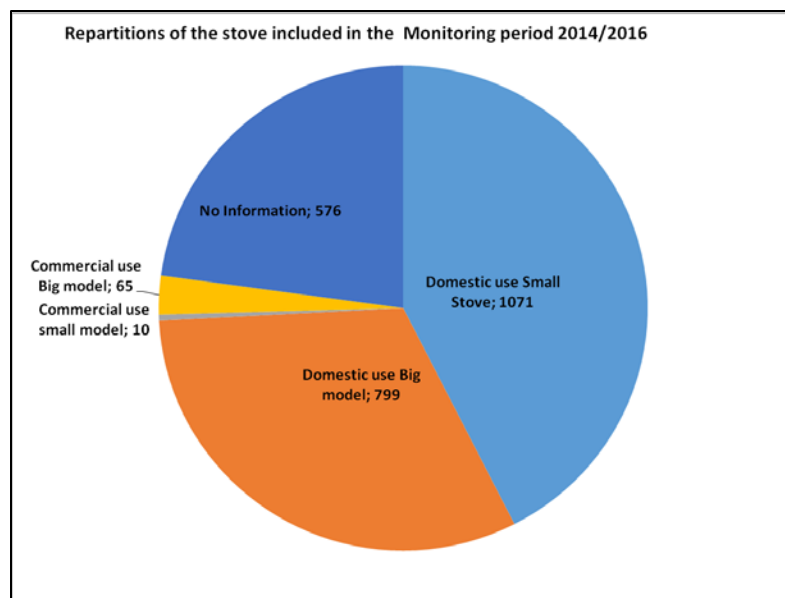


Figure 1: Ref ER calcs sheet 'project database'

The “no information” category includes stoves for which at least one information was missing (either stove size or stove intended usage). Conservative simplification detailed in paragraph IV.B.2 and IV.C.1 show that this information is not critical for accurate emission reduction calculation.

Monitoring year	Total ICS in project database	Number of ICS <sup>1</sup> considered for VER's calculations
2014 - 2015	1907	1625 (from 1 <sup>st</sup> August 2014 till 31 <sup>st</sup> July 2015)
2015 - 2016	2757	2264 (from 1 <sup>st</sup> August 2014 till 31 <sup>st</sup> July 2016)

From the period Nov'2013 till July 2015, a total of 1907 ICS's were sold and recorded in the project database and whereas for the period Nov'2013 till December 2016, a total of 2757 ICS's were sold and recorded. The ICS's which were recorded incorrectly have not been taken into account and therefore, 1625 ICS's and 2264 ICS's were taken into account for the first and second monitoring year respectively.

However, the improved stoves were not all sold before the start of each of the monitoring years. For each stove, we calculated the number of days they have been used and aggregated that in a number of full year stove equivalent. The 1567 stoves sold are equivalent to 1128 stoves being used during the whole year.

<sup>1</sup> ICS – Improved Cook-stove

The stoves from the year 2013 are not included in the VER's calculations as a conservative approach, even if it has been observed during the monitoring years that the ICS's sold in 2013 were still in use by some the project beneficiaries.

The stove without unique identification numbers were excluded from the VER's calculations.

### III. Usage rate of the stove and customer satisfaction

Usage rate information was acquired for stoves based on their age (date of sale) with a granularity of three month. The graph here under show how the usage rate evolve depending the on the age of the stove. The bar represents the number of stove surveyed for each age category. They are representative of the relative weight of each age category in the project database.

The weighted usage rate adopted for the monitoring year 2014-2015 is  $U_1=95.7\%$

The weighted usage rate adopted for the monitoring year 2015-2016 is  $U_1=93.4\%$

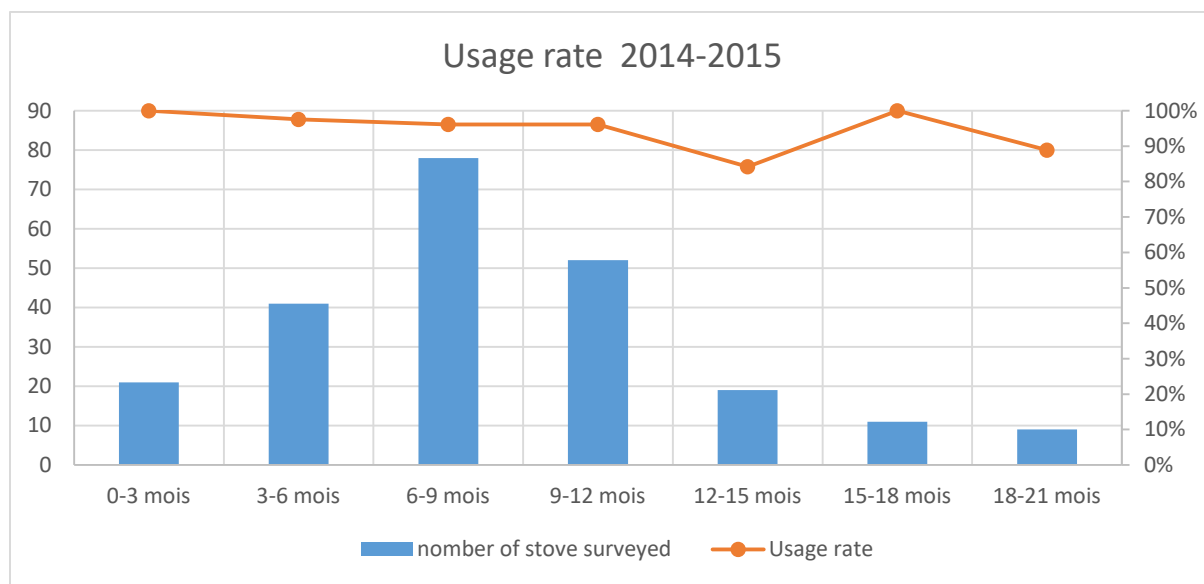


Figure 2: Ref ER calc sheet 'Usage rate'

## IV. Calculation of Emission Reduction

### A. Overall methodology used

We followed guidance from the TPDDTEC methodology to calculate emission reduction:

- Identify among stove users the type of fuel they are using now and before they purchased the Congo Mbote so that scenario trajectories may be established
- Compute baseline fuel consumption in kg/person.meal for each scenario
- Compute project fuel consumption in kg/person.meal
- Calculate emission savings per person.meal for each combination of baseline/project scenario

- Calculate emission savings per stove per year by integrating average number of peron.meal/year
- Calculate overall project emission reduction by integrating the number of used stove in each category.

We adapted the equation proposed by the TPDDTEC methodology so that **specific** emission reductions are compared between project and baseline. This is important because the Congo Mbote comes in two sizes; the household who buy the large version of the Congo Mbote tend to have larger families than the one that buy the small version. The thermal efficiency and overall technology of the two version is however similar.

## B. Baseline and project scenario trajectories

### 1. Type of fuel used

This pie chart shows the trajectory of each of the Congo Mbote user surveyed: the scenario they belonged to before they purchased the Congo Mbote and how the purchase of the Congo Mbote stove influenced their fuel usage habits.

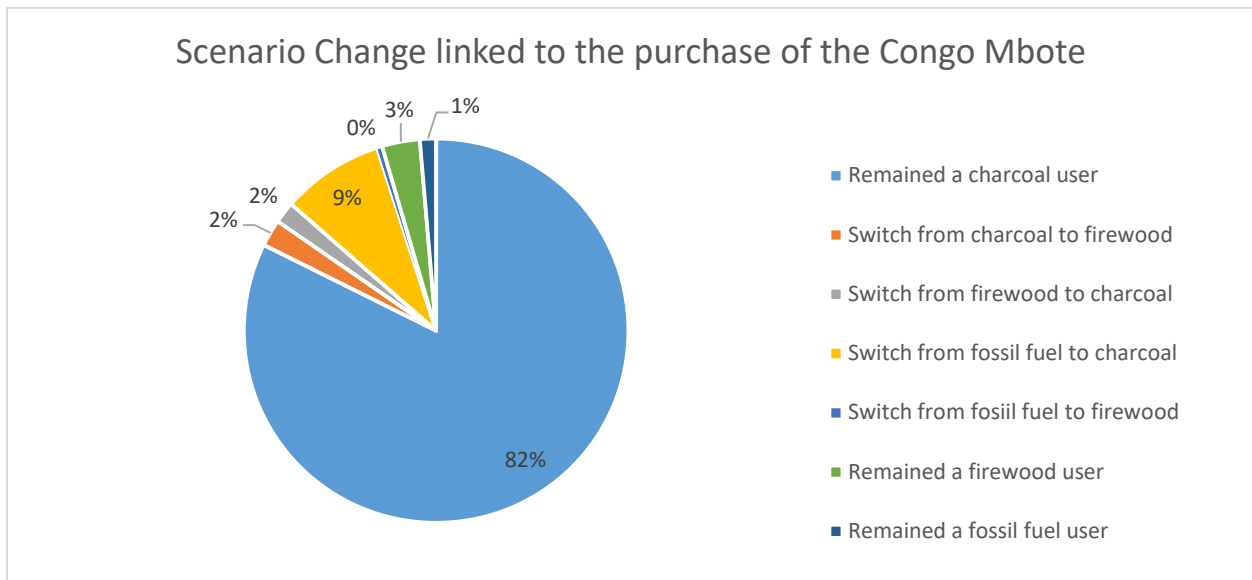


Figure 3: ER calc sheet 'monitoring survey charts 2015'

We can see that majority of users (82%) are charcoal users, they were using charcoal before their purchase and they continued after acquiring the Congo Mbote.

9% percent of the users used fossil fuel only before purchasing the stove and since they purchased it they are using charcoal. For this category of users the environmental impact is going to be negative since emission associated to charcoal are a lot higher than for LPG or Kerosene.

2% of the users switched from firewood to charcoal, for this category too the environmental impact is going to be negative.

0% of user switches from fossil fuel to firewood

2% switch from charcoal to firewood, for this category the environmental impact would be maximum but project firewood consumption has not been investigated due to the small percentage of users (see next section for more details).

## 2. Size of the stove used

For this first monitoring report, we surveyed separately household with different model to see what the fuel consumption would be. The result shows that the specific emission (in tCO<sub>2</sub>e per person\*meal) is very similar (see table here under). So we included both model in the same scenario like allowed by the methodology.

	firewood kg/person.meal	charcoal kg/person.meal	kerosene kg/person.meal	LPG kg/person.meal	person *meal	emission tCO <sub>2</sub> e/(person.meal)	Reference
Big size	0.005	0.166	0.0006	0.0191	10.4	0.000432	ER calcs sheet 'KPT Project Large Stove'
Small Size	0.0209	0.154	0.0005	0.0096	8.2	0.000427	ER calcs sheet 'KPT Project Large Stove'

## C. Integration of Congo Mbote stove in the household cooking system

In big urban centers like Brazzaville, household typically use a variety of fuel for their cooking needs. This chart show how often each type of fuel is used among the Congo Mbote user surveyed.

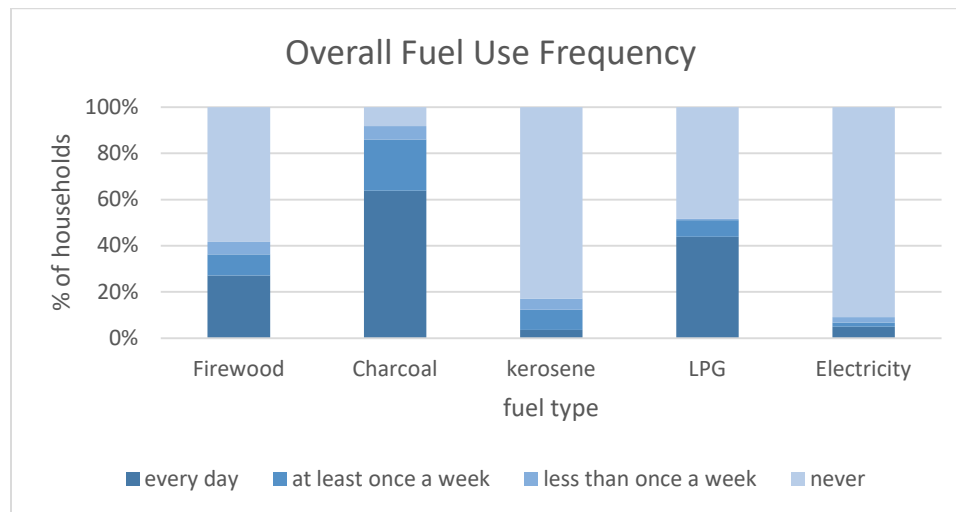


Figure 4: ER calc sheet 'Monitoring Survey Charts\_2015'

The Congo Mbote stove may be used with either charcoal or firewood. So it is competing directly with traditional firewood and charcoal stoves in the household. We investigated in the monitoring survey how often each type of stove was used.

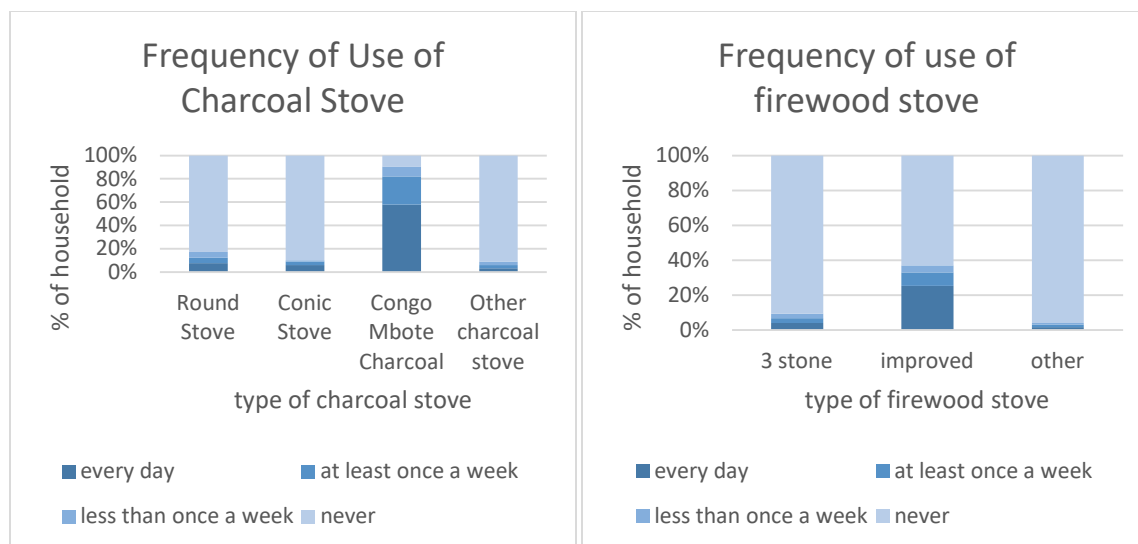


Figure 5: ER Calc sheet 'Monitoring Survey Charts\_2015'

These chart shows that the Congo Mbote has mostly displaced the use of the traditional stoves.

#### D. Green House Gas Emissions per scenario

##### 1. Summary of the conservative simplifications adopted

Because of the high number of baseline and project scenario some conservative simplifications were made. This allowed us to reduce the field work to something more manageable given the small size of the project.

	Baseline	Project
<b>Domestic Charcoal</b>	KPT	KPT
<b>Domestic Firewood</b>	KPT	Excluded from project (no emission reduction)***
<b>Domestic Fossil Fuel</b>	Assumed to be zero*	N/A
<b>Restaurant Charcoal</b>	Assumed to be same a Domestic Charcoal**	
<b>Restaurant Firewood</b>	Assumed to be same Domestic Firewood**	

\* Baseline fossil fuel: because of the small number of people using only fossil fuel and the limited emission from this category it was not deemed worthwhile to do a full fledged KPT for this scenario. We deemed this category has no emission, this is conservative.

\*\* The restaurant have a much more intensive usage of the stove and their fuel consumption is a lot higher than domestic households. So considering that one restaurant achieve the same amount of emission reduction as household is very conservative.

\*\*\* The monitoring survey show that 5% of the Congo Mbote customers use only firewood. 3% remained a firewood user and 2% switch from using charcoal in the baseline to firewood in the project. It was not deemed worthwhile to do a full fledged KPT for the category given the size of the project. As a result no emission reduction are claimed for this category. This is conservative.

## 2. Results for each individual scenario

The table here under show the results for each scenario surveyed. The KPT was undertaken during 4 consecutive days (72 hours period) during which firewood, charcoal, LPG and Kerosene fuel consumption were monitored as well as the number of meal cooked and person eating.

The emissions were calculated as per the TPDDTEC methodology and include CO<sub>2</sub>, N<sub>2</sub>O and CH<sub>4</sub>. The default NCV value and Emission Factors are available in the VPADD. Emissions are displayed in tCO<sub>2</sub>e per person.meal to make the result more comparable. Indeed the average number of person.meal in each scenario is different and would have prevented to compare the fuel consumption accurately.

Scenario	Average tCO <sub>2</sub> e/(person.meal)	Standard Deviation tCO <sub>2</sub> e/(person.meal)	Number of Survey
Baseline Firewood	0.0015	0.0007	31
Baseline Charcoal	0.0049	0.0017	57
Project Charcoal	0.0027	0.0016	70

## 3. Results for each scenario combination

The following equation is used to compute the bounds of the 90% one sided confidence interval:

$$CI\ bounds = \mu_{BL} - \mu_{PR} \pm 1.26 \sqrt{\frac{\sigma_{BL}^2}{n_{BL}} + \frac{\sigma_{PR}^2}{n_{PR}}}$$

With the following notation respectfully for the baseline and the project

$\sigma$  : Standard deviation

$\mu$ : average

n: sample size

Baseline Scenario	Project Scenario	average of emission reduction in tCO <sub>2</sub> e/(person.meal)	emission reduction, low bound of the 90% one-sided confidence interval in tCO <sub>2</sub> e/(person.meal)	emission reduction, high bound of the 90% one-sided confidence interval in tCO <sub>2</sub> e/(person.meal)	VER per household (ton/house hold/year)
Charcoal	Charcoal	0.0022	0.0018	0.0026	7.32
Firewood	Charcoal	-0.0012	-0.0015	-0.0010	-4.04
Fossil Fuel	Charcoal	-0.0027	-0.0030	-0.0025	-9.17

For each of these three combinations of scenario the one sided 90% confidence interval is within +- 30% of the average, so the difference of the means maybe used to calculate emission reductions.

The VER per household were obtained by multiplying specific emission reduction in tCO<sub>2</sub>e per person\*meal by the weighted average of number of person\*meal per year derived from the project KPT.

### E. Calculation of Greenhouse gas emissions reduction at the project level

To get to the VER at the project scale, the emission reduction for each category were multiplied by the number of stove sold, the usage rate and the percentage of users in each category

#### **EMISSION REDUCTIONS FOR THE MONITORING YEAR 2014-2015**

Baseline Scenario	Project scenario	Full year stove equivalent	usage rate	% of users	number of household	emission reductions (tCO2e/year)
Charcoal	Charcoal	321720.00	95.7%	82.4%	1338	5 103
Fossil fuel	Charcoal	321720.00	95.7%	9.5%	154	-735
Firewood	Charcoal	321720.00	95.7%	1.8%	29	-62
Firewood	Firewood	321720.00	95.7%	3.2%	51	0
Charcoal	Firewood	321720.00	95.7%	2.3%	37	0
others		321720.00	95.7%	0.9%	15	0
<b>Total</b>						<b>4 307</b>

#### **EMISSION REDUCTIONS FOR THE MONITORING YEAR 2015-2016**

Baseline Scenario	Project scenario	Full year stove equivalent	usage rate	% of users	number of household	emission reductions (tCO2e/year)
Charcoal	Charcoal	455899.00	93.4%	83.4%	1872	7 166
Fossil fuel	Charcoal	455899.00	93.4%	6.7%	197	-713
Firewood	Charcoal	455899.00	93.4%	3.1%	49	-231
Firewood	Firewood	455899.00	93.4%	1.5%	61	-
Charcoal	Firewood	455899.00	93.4%	2,1%	50	-
others		455899.00	93.4%	3.1%	34	-
<b>Total</b>						<b>6 222</b>

<b>Total Emission reductions 2014-2015: August 1<sup>st</sup> 2014 to July 31<sup>st</sup> 2015</b>	<b>4307 tCO2e</b>
<b>Total Emission reductions 2015-2016: August 1<sup>st</sup> 2015 to July 31<sup>st</sup> 2016</b>	<b>6222 tCO2e</b>
<b><i>*First and last dates of the monitoring period are included</i></b>	

## V. Overall socio-economic impacts from the project

These two chart were established independently for traditional charcoal stove user and Congo Mbote stove users respectively. In all categories the usual issues associated with cooking with dirty fuel are greatly mitigated.

