



Monitoring Report

Production and dissemination of Ceramic Water Purifiers by Hydrologic, in the Kingdom of Cambodia – GS1020

GS Registration Date: 08/08/2012

Monitoring period 3: 01/05/2013 – 30/04/2014

Project Participant: Hydrologic Social Enterprise, Ltd.

Host Party: Kingdom of Cambodia

Sectoral Scope: 3 – Energy Demand

Methodology: “Technologies and Practices to Displace Decentralized Thermal Energy Consumption – 11/04/2011”

Estimated amount of GHG emission reductions for this monitoring period in the registered PDD: 94,448

Actual GHG emission reductions achieved in this monitoring period: 92,463



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1 General project activity information

1.1 Title of the project activity

"Production and dissemination of Ceramic Water Purifiers by Hydrologic, in the Kingdom of Cambodia"

1.2 Gold Standard registration number

GS1020, registration date: 08/08/2012

1.3 Short description of the project activity

Project Participant: Hydrologic Social Enterprise Ltd.

Background

In December 2010, NGO International Development Enterprise (IDE Cambodia) spun off its CWP manufacturing program creating a subsidiary called Hydrologic Social Enterprise. Through their Voluntary Gold Standard registered project "GS1020 - Production and Dissemination of Ceramic Water Purifiers by Hydrologic in the Kingdom of Cambodia," Hydrologic has disseminated 61,536 units in year 2013 from 01/01/2013 to 31/12/2013 and 64,143 units during the monitoring period from 01/05/2013 to 30/04/2014 and 175,902 units over the crediting period, with an estimated 114,527 units in use as of 30 April 2014.¹ These CWPs are providing access to adequate levels of clean drinking water to an estimated 1,012,746 people in Cambodia.² The treatment of contaminated drinking water with a CWP reduces the demand for treating water by boiling with non-renewable biomass, thus reducing greenhouse gas emissions.

With the assistance of carbon finance, this project can be economically sustainable and provide a significant improvement in public health and household welfare.

Location

The project boundary for the distribution of the Hydrologic Ceramic Water Purifiers is the Kingdom of Cambodia. From the latter half of 2012 Hydrologic has scaled up sales operations and now has direct sales agents in 15 provinces. The map below shows the location of the Hydrologic factory.

¹ See HSE HH MP3 ER Calculations, Tab "Units per month" and tab "MP3 Usage Rate Calc". 161,306 cumulative units credited * 0.71 usage rate = 114,527 units in use

² See "Hydrologic (2013) MP2 MR," page 2. Hydrologic served 672,789 people in MP1 and MP2; In MP3, 64,143 CWPs sold * 5.30 persons per household = 339,957 people served in MP3; 339,957 + 672,789 = 1,012,746.



Figure 1 - Map of Cambodia

1.4 Monitoring period

From 01/05/2013 to 30/04/2014

1.5 Methodology applied to the project activity

"Technologies and Practices to Displace Decentralized Thermal Energy Consumption - 11/04/2011"

1.6 Status of implementation including time table for key dates

The project sold 64,143 Ceramic Water Purifiers (CWP) during the period from 01/05/2013 to 30/04/2014, and reduced 92,463 tonnes of GHG emissions (tCO₂e). During that period, PP has been monitoring closely all the activities required by GS.

This project is an end-use energy efficiency improvement project, registered under the Voluntary Gold Standard methodology: "Technologies and Practices to Displace Decentralized Thermal Energy Consumption."³

³ The Gold Standard (2011) *Technologies and Practices to Displace Decentralized Thermal Energy Consumption*. [Online] Available from: http://www.cdmgoldstandard.org/wp-content/uploads/2011/10/GS_110411_TPDDTEC_Methodology.pdf [Last Accessed 5th June 2013].

The project has been implemented as described in the PDD in section A.4.2. The technology used during this monitoring period is the same as described in the PDD and in Hydrologic's Monitoring Reports from the 1st and 2nd Monitoring Periods. There has been no change in the technology.

Project Activities

During the third monitoring period, between 01/05/2013 to 30/04/2014, Hydrologic has made significant strides towards achieving its goals. Hydrologic has manufactured and sold 64,143 CWPs to households throughout the Kingdom of Cambodia, bringing the total over the lifetime of the project to 175,902.⁴

The starting date of operation of the project activity was 01/12/2010, when production of CWPs for the crediting period began, and will continue through 30/11/2017.

The Ceramic Water Purifiers are sold throughout the Kingdom of Cambodia, as outlined in Section 1.3, and are not installed at the start of the project, but are installed progressively during the 7-year crediting period. The table in Section 5 "Timeline for Dissemination of Units" reflects the installation rate per month from 01/05/2013 to 30/04/2014.

Hydrologic produced all the filters at their purpose-built factory in Cambodia. Local production using locally available skills has continued to provide low-cost production while providing gainful employment to local people.

Hydrologic has maintained a total sales record of all sales through three main channels:

- i) Direct sales to end users by hydrologic sales staff
- ii) Sales to retail sales agents who purchase CWPs whole sale and sell them to retailers and local intermediaries
- iii) NGOs that purchase wholesale CWPs and typically sell them at a subsidized price.

For direct sales, Hydrologic holds meetings to share with interested communities the potential benefits of the CWP. At these meetings, through a partnership with World Vision's microfinance wing, Vision Fund, households who qualify can purchase the CWPs with a 6-month low interest loan. For retail sales, Sales Agents working on commission sell CWPs to retailers throughout several provinces. Hydrologic also sells the purifiers to NGOs wishing to distribute or sell the CWPs at subsidized rates. Additionally, throughout the monitoring period, Hydrologic has maintained a project database containing the contact details of all end users, to the extent possible.

In May 2014, Hydrologic conducted a Water Consumption Field Test, a Project Survey, and a Usage Survey to accurately calculate the monitoring parameters outlined in the Project Design Document and Gold Standard Passport.

Hydrologic has implemented ongoing monitoring of sales, end-user contact details, usage rates and leakage. The sales database records monthly sales of the CWPs and the project database records end-user information, when feasible. Hydrologic has monitored the usage rates of the CWPs through the project survey to ensure the project claims an appropriate useful life of the technology. End-users have the opportunity to replace broken parts or the entire unit at no cost through a 2-year warranty system. This system extends the lifespan of the CWP by providing a warranty card with the

⁴ See "Hydrologic (2013) MP2 ER Calculations". Hydrologic sold 66,565 units in MP1 and 45,194 in MP2. (66,565 + 45,194 = 111,759)

information necessary to replace broken parts or units in the box of each CWP. End-users are also provided with detailed instructions outlining the proper care and maintenance of the CWP. Hydrologic has also monitored the sources of leakage identified by the leakage assessment conducted in the first Monitoring Period, namely wood used for firing the CWPs in the factory kilns.

Hydrologic has also fully implemented the actions mitigating against double counting as outlined in the PDD, including:

- i. Hydrologic has added a serial number to all water filters produced and kept the numbers in a database;⁵
- ii. The design of the water filters from Hydrologic look physically different from other water filters in the market, making it easy to recognize them; and
- iii. Hydrologic will only account for the water filters coming out of their factory, thus removing the risk that other water filters may be double counted.⁶

The sale of 64,143 Ceramic Water Purifiers (CWPs) between 01/05/2013 and 30/04/2014 is on target to projected sales volumes.

The sources of funding and or grants have not changed since the last verification.

1.7 Intended deviations or revisions to the registered PDD

Since the last verification, the project proponent requested and achieved a design change to the PDD from the Gold Standard. The summary of the Gold Standard Design Change Review is below:

“GS1020 registered with the Gold Standard 8 August 2012 as a small-scale project, and has undergone verification twice, issuing Voluntary Emission Reductions (VERs) in December 2012 and December 2013. Since registration, the project has out-performed emission reduction expectations. Water Boiling Tests and Water Consumption Tests revealed higher than estimated emissions reductions per Ceramic Water Purifier (CWP) in the Project Design Document (PDD), and sales of CWPs have exceeded forecasts. Due to this, in the second monitoring period, the project exceeded the small-scale limit of 180 GWh of energy saved per annum.

In addition, during the GS Technical Review of the 2nd verification, the GS requested the PP to apply usage rates derived from usage surveys in accordance with the methodology, instead of claiming 100% usage for two years, and then retiring all units after 2 years.

In advance of the 3rd verification, the PP would like to request a design change to adjust the scale of the project to large scale.”

A summary of the design changes made to the PDD and GS Passport can be found in the document Hydrologic (2014) “Design Change Memo”.⁷

While the PP addressed all of the Comments/Requests of the GS, except for a Forward Action Request:⁸

⁵ HSE HH MP3 Serial numbers CWP

⁶ HSE MP3 Sales database

⁷ Hydrologic (2014) Design Change Memo

⁸ Gold Standard (2014) “GS1020_Design Change Review_final 2014-03-27”

Forward Action Request #1. Since the scale of project activity has been changed, the PP shall conduct a stakeholder feedback round in order to seek comments about the changes from local stakeholders. The PP may carry out the SFR online or by any other effective methods and provide the summary of the outcome at the time of next issuance with DOE's opinion.

On 8 April 2014, the PP requested that the revised GS Passport and PDD be made publicly available on the Markit Registry website.⁹ On the same date, the PP also made these documents available on its website: www.hydrologichealth.com

To date, the PP has received only one feedback from stakeholders, which is summarized below in Section 4.3, Table 7 below. The PP will keep the documentation available on its website.

In addition, during the GS Technical Review of the 3rd verification, the GS noticed that there are two different fuels wood and charcoal that are being used in the baseline/project situations. Ideally, different baseline fuels shall be accounted under separate baseline scenarios. In such a situation the baseline surveys and other relevant monitoring requirements should be carried out for each scenario independently. Or alternatively, the PP should have opted for most conservative fuel as for both baseline scenarios. Based on the GS observation PP has decided to use wood for both baseline scenario.

1.8 Intended deviations or revisions to the registered monitoring plan

None.

1.9 Changes since last verification

None.

1.10 Person(s) responsible for the preparation and submission of the monitoring report

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⁹ HSE HH MP3 SFR GS PUBLICATION EMAIL REQUEST

2 Key monitoring activities according to the monitoring plan

Data / Parameter:	$Q_{p,y}$
Unit:	Litres per person per day
Description:	Quantity of safe water supplied in the project scenario p during the year y, using CWP
Measured/Calculated/Default:	Measured/Calculated
Source of data:	Water Consumption Field Test (WCFT)
Value(s) of monitored parameter:	1.780
Monitoring equipment:	10 scales (Each of the research teams carried with them 1 scale to measure water consumption) Also see "HSE HH MP3 WCFT Report"
Measuring/ Reading/ Recording frequency:	Before first verification and every two years.
Calculation method (if applicable):	The calculations are completed by the statistician team, as explained in "HSE HH MP3 WCFT REPORT" which includes the protocol applied.
QA/QC procedures:	Data collected during the tests were collected and the results were registered in a datasheet by an independent, qualified Data Entry Clerk. All data entry was spot checked for errors by Hydrologic's carbon project coordinator. Following the encoding process, the analysis was led by the iDE Technical Advisor with statistical skills. The data and initial analysis was sent to the statistician team to generate the final results which were then validated by the Carbon Project Officer at Nexus. See "HSE HH MP3 WCFT Report" for the full report. Raw data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Information Flows".
Purpose of data:	Baseline/Project emission calculations
Calibration requirements:	Scales: <ul style="list-style-type: none"> a) Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams b) Frequency: The calibration should be completed every time a new set of water consumption field tests has to be performed Also see "HSE HH MP3 Calibration&Inventory" for equipment calibration requirements.
Additional comment:	

Data / Parameter:	$Q_{p,rawboil,y}$
Unit:	Litres per person per day
Description:	The raw or unsafe water that is still boiled after installation of the CWP
Measured/Calculated/Default:	Measured/Calculated
Source of data:	Water Consumption Field Test
Value(s) of monitored	1.400

parameter:	
Monitoring equipment:	10 scales (Each of the research teams carried with them 1 scale to measure water consumption) Also see "HSE HH MP3 WCFT Report"
Measuring/ Reading/ Recording frequency:	Before first verification and every two years
Calculation method (if applicable):	The calculations are completed by the statistician team, as explained in "HSE HH MP3 WCFT REPORT" which includes the protocol applied.
QA/QC procedures:	Data collected during the tests were collected and the results were registered in a datasheet by an independent, qualified Data Entry Clerk. All data entry was spot checked for errors by Hydrologic's carbon project coordinator. Following the encoding process, the analysis was led by the iDE Technical Advisor with statistical skills. The data and initial analysis was sent to the statistician team to generate the final results which was then validated by the Carbon Project Officer at Nexus. See "HSE HH MP3 WCFT Report" for the full report. Raw data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Information Flows".
Purpose of data:	Baseline/Project emission calculations
Calibration requirements:	Scales: <ul style="list-style-type: none"> c) Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams d) Frequency: The calibration should be completed every time a new set of water consumption field tests has to be performed Also see "HSE HH MP3 Calibration&Inventory" for equipment calibration requirements.
Additional comment:	

Data / Parameter:	$Q_{p, \text{cleanboil}, y}$
Unit:	Litres per person per day
Description:	Quantity of safe water (treated or from safe supply) boiled in the project scenario p, after installation of the CWP
Measured/Calculated/ Default:	Measured/Calculated
Source of data:	Water Consumption Field Test
Value(s) of monitored parameter:	0.011
Monitoring equipment:	10 scales (Each of the research teams carried with them 1 scale to measure water consumption) Also see "HSE HH MP3 WCFT Report"
Measuring/ Reading/ Recording frequency:	Before first verification and every two years
Calculation method (if applicable):	The calculations are completed by the statistician team, as explained in "HSE HH MP3 WCFT REPORT" which includes the protocol applied.
QA/QC procedures:	Data collected during the tests were collected and the results were registered in a datasheet by an independent, qualified Data Entry Clerk. All data entry was spot checked for errors by Hydrologic's carbon project coordinator. Following the encoding process, the analysis was led by the iDE Technical Advisor with

	statistical skills. The data and initial analysis was sent to the statistician team to generate the final results which was then validated by the Carbon Project Officer at Nexus. See "HSE HH MP3 WCFT Report" for the full report. Raw data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Information Flows".
Purpose of data:	Baseline/Project emission calculations
Calibration requirements:	<p>Scales:</p> <ul style="list-style-type: none"> e) Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams f) Frequency: The calibration should be completed every time a new set of water consumption field tests has to be performed <p>Also see "HSE HH MP3 Calibration&Inventory" for equipment calibration requirements.</p>
Additional comment:	

Data / Parameter:	Quality of the water treated
Unit:	As appropriate in alignment with QA/QC procedures
Description:	Performance of the CWP
Measured/Calculated/Default:	Measured
Source of data:	Lab test
Value(s) of monitored parameter:	N/A
Monitoring equipment:	No monitoring equipment needed as the analysis is completed in a third party laboratory as explained in HSE HH MP3 "Water Quality Test Reports"
Measuring/ Reading/ Recording frequency:	Before first verification and every two years
Calculation method (if applicable):	See HSE HH MP3 "Water Quality Test Reports"
QA/QC procedures:	CWPs were tested for performance by a 3rd party during the monitoring period. The CWP selection and preparation by Hydrologic for the tests is overseen by and double checked by the Carbon Project Manager at Hydrologic by spot checking preparation. The CWPs are sent to a 3 rd party laboratory in Phnom Penh to generate the results, which are then validated by the Carbon Project Officer at Nexus. See HSE HH MP3 "Water Quality Test Reports".
Purpose of data:	Sustainable Development Indicator (Water Quality)
Calibration requirements:	None. (Done by laboratory.)
Additional comment:	

Data / Parameter:	$U_{p,y}$
Unit:	Percentage
Description:	Usage rate in project scenario p during year y
Measured/ Calculated/ Default	Measured and Calculated (Weighted Average)
Source of data:	Annual usage survey – Project Survey (PS)
Value(s) of monitored parameter:	71%

Monitoring equipment:	None.
Measuring/ Reading/ Recording frequency:	Annually
Calculation Method (if applicable):	See "HSE HH MP3 USAGE SURVEY REPORT"
QA/QC procedures:	Data collected during the tests were collected and the results were registered in a datasheet by an independent, qualified Data Entry Clerk. All data entry was spot checked for errors by Hydrologic's carbon project coordinator. Following the encoding process, the analysis was led by the iDE Technical Advisor with statistical skills. The data and initial analysis was sent to the statistician team to generate the final results which was then validated by the Carbon Project Officer at Nexus. See "HSE HH Usage Survey Report" for the full report. Raw data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Information Flows". Raw data will be available on request to the DOE.
Purpose of data:	Baseline/Project emission calculations
Calibration requirements:	None.
Additional comment:	The Usage Questionnaire was designed with simple and understanding questions with reference to the updated Gold Standard "Guidelines for carrying out usage surveys for projects implementing household water filtration technologies – 05/02/2014"

Data / Parameter:	$N_{j,y}/N_{p,y}$
Unit:	Person.days
Description:	Number of persons consuming water supplied by project scenario p through year y
Measured/ Calculated/ Default	Measured/Calculated
Source of data:	Water Consumption Field Test
Value(s) of monitored parameter:	1,933.77 (per water filter per year)
Monitoring equipment:	10 scales (Each of the research teams carried with them 1 scale to measure water consumption) Also see "HSE HH MP3 WCFT Report"
Measuring/ Reading/ Recording frequency:	Before first verification and every two years
Calculation Method (if applicable):	Total of person.days = number of days in use (365) * number of units per household (1) * number of persons per household (5.298) = 1.933.77 person.days See "HSE HH MP3 WCFT Report"
QA/QC procedures:	See "HSE HH MP3 WCFT Report" for the full report. Raw data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Information Flows".
Purpose of data:	Baseline/Project emission calculations
Calibration requirements:	Scales: a) Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams b) Frequency: The calibration should be completed every time a new set of water consumption field tests has to be performed

	Also see “HSE HH MP3 Calibration&Inventory” for equipment calibration requirements.
Additional comment:	

Data / Parameter:	LE _{p,y}
Unit:	tCO2e per year
Description:	Leakage in project scenario p during year y
Measured/ Calculated/ Default:	Calculated
Source of data:	Firewood Use at Factory
Value(s) of monitored parameter:	0.014 tCO2e (per water filter per year)
Monitoring equipment:	None.
Measuring/ Reading/ Recording frequency:	Every two years
Calculation method (if applicable):	<p>Leakage = Weight of wood per m3 * Quantity of wood purchased for factory * Carbon content in wood * (molecular weight of CO2/molecular weight of Carbon) / conversion from kg to tonnes / number of units sold</p> <p>289.72 kg per m3 * 1,698.00 m3 * 0.50 * (44.00/12.00) / 1000 / 64,143 units = 0.014 tCO2e</p> <p>See "HSE HH MP3 FACTORY WOOD AND DIESEL USE" and "HSE HH MP3 ER Calculations"</p>
QA/QC procedures:	The cubic meters of firewood in each truck load of wood purchased is recorded in every receipt. The finance department verifies the receipts and enters the amount of wood into the accounting system. The Carbon Project Officer at Nexus spot checks the receipts and validates the spreadsheets. See "HSE HH MP3 FACTORY WOOD AND DIESEL USE". Also see "HSE HH MP3 Monitoring Info Flows".
Purpose of data:	Leakage emissions calculations
Calibration requirements:	None.
Additional comment:	<p>1. The PP also tracks diesel gas used to power generators for electricity at the factory, however these emissions were determined to be immaterial as they represent 0.03% of the emission reductions achieved in the monitoring period.</p> <p>In this monitoring period, the PP purchased 10,298 liters of Diesel, as shown in "HSE HH MP3 FACTORY FIREWOOD AND DIESEL USE", which represents 27.92 tCO2, as calculated below:</p> <p>tCO2 from Diesel = Liters of Diesel (L) * Density of Diesel (kg/L) / 1000 (kg to tonnes) * Net Calorific Value of Diesel (GJ/tonne) * Emission Factor of Diesel (tCO2/GJ)</p>

	<p>10,298 L * 0.837 kg/L¹⁰ / 1000 (kg to tonnes) * 43.3 GJ/tonne¹¹ * 0.0748 tCO₂/GJ¹² = 27.92 tCO₂</p> <p>Percentage of Emission Reductions (%) = Emissions from Diesel / Emission Reductions in the Monitoring Period</p> <p>27.92 tCO₂ / 93,537 tCO₂e = 0.0003 or 0.03 %</p> <p>2. The PDD specifies that the PP shall monitor Leakage using “monitoring surveys”, as specified in the PDD. For this methodology, this refers to the project activity replacing a lower emissions method of water treatment. While the project activity is a zero-emissions solution, the PP still asked end-users in the Project Survey if they had been treating water, what treatment method they used. Of those who treated water, 80% (100) were boiling water, 9.6% (12) were letting water stand and settle, 6.4% (8) were using chlorine treatment, and 3.2% (4) were using some other type of water filter, as shown in “HSE HH MP3 PROJECT SURVEY REPORT”. The PP has therefore concluded that it has not replaced a lower emitting device, and that it does not need to assess this form of leakage.</p>
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Data / Parameter:	Units sold
Unit:	CWPs
Description:	Number of units sold during project activity
Measured/ Calculated/ Default:	Measured
Source of data:	Sales Records
Value(s) of monitoring parameter:	<p>Number of units sold from start of the project activity Dec 2010 to April 2014 - 175,902</p> <p>Number of units sold during year 2013- 61536</p> <p>Number of units sold during 3rd monitoring period, May 2013 to April 2014 - 64,143 units</p>
Monitoring equipment:	None
Measuring/ Reading/ Recording frequency:	Before each verification
Calculation method (if applicable):	Sales Records
QA/QC procedures:	Data comes from 3 sales channels: direct, retail, and NGO sales. The finance department ensures that all sales numbers are accurate by reconciling sales data with payments, and entering the sales into their accounting system, Peachtree. The Carbon Project Officer at Nexus verifies the monthly sales data

¹⁰ https://www.dieselnet.com/standards/eu/fuel_reference.php, Table 1.1; Value is 837 kg/m³ converted to Liters = 837 /1000 m³/L = 0.837 kg/L

¹¹ 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 2: Energy, Ch. 1, Table 1.2: Default Net Calorific Values (NCVs), 1.18

¹² 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 2: Energy, Ch. 1, Table 1.4: Default CO₂ Emissions Factors for Combustion, 1.23

	from the finance department and enters the data into the ER spreadsheet. See "HSE HH MP3 Sales Database May 2013 – April 2014" for the summary sales per month. All sales data will be available on request to the DOE. Also see "HSE HH MP3 Monitoring Info Flows".
Purpose of data:	Baseline/Project emissions calculations
Calibration requirements:	None
Additional comment:	

Data / Parameter:	$f_{NRB,y}$
Unit:	%
Description:	Non-renewable biomass ratio
Measured/ Calculated/ Default:	Measured/Calculated
Source of data:	NRB assessment in PDD
Value(s) of monitored parameter:	73.28%
Monitoring equipment:	None.
Measuring/ Reading/ Recording frequency:	The NRB will be updated when new values are available.
Calculation method (if applicable):	$fNRB = NRB / H$ $NRB = H - MAI$ $NRB = 34,392 - 9,191 = 25,201tDM$ $fNRB = 25,201 / 34,392 = 73.28\%$ Calculated According to The Gold Standard Methodology "Technologies and Practices to Displace Decentralized Thermal Energy Consumption – 11/04/2011". The full calculation is available in section B.4 of the PDD
QA/QC procedures:	See Hydrologic "PDD DESIGN CHANGE", Section B.4
Purpose of data:	Baseline/ Project emission calculations
Calibration requirements:	None.
Additional comment:	The CDM Executive Board has released a new fNRB which 76% ¹³ and is higher than the one used here. PP will use the new fNRB once the figure will be accepted by the DNA from Cambodia.

¹³ UNFCCC (2012) Default Values of fNRB for LDCs

http://cdm.unfccc.int/filestorage/H/2/9/H29X6EKQMJU7RY85DIT4ZPFAL3O1GW/eb67_repan22.pdf?t=clF8bTZkMWV1fDAha2ITf7cHgOriMZPb3QWj

3 Key non-monitoring default values

These values are unchanged from the first verification.

Data / Parameter:	$X_{nrb,bl,y}$
Unit:	Fraction
Description:	Non-renewability of woody biomass fuel in year y in baseline scenario
Source of data:	Study; refer to Section B.6.1 of PDD
Value(s) applied:	0.7328
Purpose of data:	Baseline/Project emission calculations
Additional comment:	

Data / Parameter:	C_j
Unit:	Fraction
Description:	Portion of users of the project technology j who in the baseline were already consuming safe water without boiling it
Source of data:	Baseline report
Value(s) applied:	2.60%
Purpose of data:	Baseline/Project emission calculations
Additional comment:	

Data / Parameter:	$EF_{b,wood,CO2}$ / $EF_{p,wood,CO2}$
Unit:	tCO ₂ /TJ
Description:	CO ₂ emission factor arising from use of fuels in baseline/project scenario
Source of data used:	IPCC Guidelines for National Greenhouse Gas Inventories", Volume 2, Energy, Chapter 2, Stationary Combustion, Table 2.5
Value(s) applied:	112.00
Purpose of data:	Baseline/Project emission calculations
Additional comment:	

Data / Parameter:	$EF_{b,wood,nonCO2}$ / $EF_{p,wood,nonCO2}$
Unit:	tCO _{2e} /TJ
Description:	Non-CO ₂ emission factor arising from use of fuels in baseline/project scenario
Source of data:	For wood emission CH ₄ /N ₂ O: IPCC Guidelines for National Greenhouse Gas Inventories", Volume 2, Energy, Chapter 2, Stationary Combustion, Table 2.5 For GWP: IPCC (2007) "IPCC Fourth Assessment Report: Climate Change 2007/ Climate Change 2007/ Working Group I: The Physical Science Basis 2.10.2 Direct Global Warming Potential" available at [last accessed 05-12-2012]: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html
Value(s) applied:	8.69 ((CH ₄ =0.3*GWP 25) + (N ₂ O=0.004*GWP 298))
Purpose of data:	Baseline/Project emission calculations
Additional comment:	

Data / Parameter:	NCV _{b,wood} / NCV _{p,wood}
Unit:	TJ/ton
Description:	Net calorific value of the fuels used in baseline/ project scenario
Source of data:	IPCC Guidelines for National Greenhouse Gas Inventories", Volume 2, Energy, Chapter 2, Stationary Combustion, Table 2.5
Value(s) applied:	0.015
Purpose of data:	Baseline/Project emission calculations
Additional comment:	

Data / Parameter:	$W_{b,y,wood}$
Unit:	Tonnes
Description:	Amount of wood required to boil 1 litre of water in baseline scenario
Measured/ Calculated/ Default:	Measured/Calculated
Source of data:	Water Boiling Test and Baseline fuel mix
Value(s) of monitored parameter:	0.000218
Monitoring equipment:	<ul style="list-style-type: none"> a) 20 liter buckets (Each of the 13 research teams worked at 4 households each week requiring 1 bucket for every household or 13(4)(1) = 52 buckets; the WBT was conducted directly after the WCFT at the same household, so buckets from the WCFT were used to save money) b) Digital Scale (Each of the 13 research teams required 1 scale. Field Supervisors (3) carried 1 spare scale each. Total 16 scales.) c) Digital Thermometer (Same as Digital Scale. 16 total.) d) Stopwatch (Same as digital scale. Total 16.) e) Measuring Tape (same as Digital Scale. 16 total. As WBT was conducted directly after the WCFT at the same household, the same measuring tapes used in the WCFT were used in the WBT) <p>Also see "Hydrologic (2012) Calibration&Inventory 2012-08-24"</p>
Measuring/ Reading/	Once before first verification.

Recording frequency:	
Calculation method (if applicable):	The formula used to reach this figure is: $W_{Wood\ required\ to\ boil\ 1\ litre\ of\ water\ with\ traditional\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} + W_{Wood\ required\ to\ boil\ 1\ litre\ of\ water\ with\ improved\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} = W_{b,y,wood}$ $0.00024 * 60.09\% + 0.00021 * 34.59\% = 0.000218\ tonnes$
QA/QC procedures:	See "Hydrologic (2012) ER calculations 2012-11-30 Verification" and " Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"
Purpose of data:	Baseline/ Project emission calculations
Calibration requirement:	<ul style="list-style-type: none"> c) 20 liter buckets <ul style="list-style-type: none"> a. Procedure: Bucket volumes are verified by checking the width of the opening and bottom of the bucket against the manufacturer's engineering specifications at a +/- 0.1 centimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test d) Digital Scale <ul style="list-style-type: none"> a. Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed e) Digital Thermometer <ul style="list-style-type: none"> a. Procedure: The thermometers are verified by checking that the maximum variation between thermometers at room temperature and room temperature after 5 minutes, and two readings at boiling temp (30 sec) and boiling temp (1 min) do not exceed a threshold of +/- 4 degrees Celsius. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed f) Stopwatch <ul style="list-style-type: none"> a. Procedure: Each stopwatch is timed against an online standard stopwatch and verified at an accuracy of +/- 2 seconds. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed g) Measuring Tape <ul style="list-style-type: none"> a. Procedure: Measuring tapes are verified by checking the measurement achieved when measuring the length of ISO certified A4 paper (297cm) at a +/- 1 millimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test <p>Also see "Hydrologic (2012) Calibration&Inventory" for equipment calibration requirements.</p>
Additional comment:	

Data / Parameter:	$W_{b,y,charcoal}$
Unit:	Tonnes
Description:	Amount of charcoal required to boil 1 litre of water in baseline scenario
Measured/ Calculated/ Default:	Measured/Calculated
Source of data:	Water Boiling Test and Baseline fuel mix
Value(s) of monitored	0.000006

parameter:	
Monitoring equipment:	<p>a) 20 liter buckets (Each of the 13 research teams worked at 4 households each week requiring 1 bucket for every household or $13(4)(1) = 52$ buckets; the WBT was conducted directly after the WCFT at the same household, so buckets from the WCFT were used to save money)</p> <p>b) Digital Scale (Each of the 13 research teams required 1 scale. Field Supervisors (3) carried 1 spare scale each. Total 16 scales.)</p> <p>c) Digital Thermometer (Same as Digital Scale. 16 total.)</p> <p>d) Stopwatch (Same as digital scale. Total 16.)</p> <p>e) Measuring Tape (same as Digital Scale. 16 total. As WBT was conducted directly after the WCFT at the same household, the same measuring tapes used in the WCFT were used in the WBT)</p> <p>Also see "Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"</p>
Measuring/ Reading/ Recording frequency:	Once before first verification.
Calculation method (if applicable):	<p>The formula used to reach this figure is:</p> $W_{Charcoal\ required\ to\ boil\ 1\ litre\ of\ water\ with\ traditional\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} + W_{Charcoal\ required\ to\ boil\ 1\ litre\ of\ water\ with\ improved\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} = W_{b,y,charcoal}$ $0.00014 * 2.44\% + 0.00009 * 2.88\% = 0.000006\ tonnes$
QA/QC procedures:	See "Hydrologic (2012) ER calculations 2012-11-30 Verification" and " Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"
Purpose of data:	Baseline/ Project emission calculations
Calibration requirement:	<p>a) 20 liter buckets</p> <ol style="list-style-type: none"> Procedure: Bucket volumes are verified by checking the width of the opening and bottom of the bucket against the manufacturer's engineering specifications at a +/- 0.1 centimeter threshold. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test <p>b) Digital Scale</p> <ol style="list-style-type: none"> Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed <p>c) Digital Thermometer</p> <ol style="list-style-type: none"> Procedure: The thermometers are verified by checking that the maximum variation between thermometers at room temperature and room temperature after 5 minutes, and two readings at boiling temp (30 sec) and boiling temp (1 min) do not exceed a threshold of +/- 4 degrees Celsius. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed <p>d) Stopwatch</p> <ol style="list-style-type: none"> Procedure: Each stopwatch is timed against an online standard stopwatch and verified at an accuracy of +/- 2 seconds. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed <p>e) Measuring Tape</p> <ol style="list-style-type: none"> Procedure: Measuring tapes are verified by checking the measurement achieved when measuring the length of ISO

	<p>certified A4 paper (297cm) at a +/- 1 millimeter threshold. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test</p> <p>Also see "Hydrologic (2012) Calibration&Inventory" for equipment calibration requirements.</p>
Additional comment:	

Data / Parameter:	$W_{p,y,wood}$
Unit:	Tonnes
Description:	Amount of wood required to boil 1 litre of water in project scenario
Measured/ Calculated/ Default:	Measured/Calculated
Source of data:	Water Boiling Test and Baseline fuel mix
Value(s) of monitored parameter:	0.000218
Monitoring equipment:	<p>a) 20 liter buckets (Each of the 13 research teams worked at 4 households each week requiring 1 bucket for every household or $13(4)(1) = 52$ buckets; the WBT was conducted directly after the WCFT at the same household, so buckets from the WCFT were used to save money)</p> <p>b) Digital Scale (Each of the 13 research teams required 1 scale. Field Supervisors (3) carried 1 spare scale each. Total 16 scales.)</p> <p>c) Digital Thermometer (Same as Digital Scale. 16 total.)</p> <p>d) Stopwatch (Same as digital scale. Total 16.)</p> <p>e) Measuring Tape (same as Digital Scale. 16 total. As WBT was conducted directly after the WCFT at the same household, the same measuring tapes used in the WCFT were used in the WBT)</p> <p>Also see "Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"</p>
Measuring/ Reading/ Recording frequency:	Once before first verification.
Calculation method (if applicable):	<p>The formula used to reach this figure is:</p> $W_{Wood\ required\ to\ boil\ 1\ litre\ of\ water\ with\ traditional\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} + W_{Wood\ required\ to\ boil\ 1\ litre\ of\ water\ with\ improved\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} = W_{b,y,wood}$ $0.00024 * 60.09\% + 0.00021 * 34.59\% = 0.000218\ tonnes$
QA/QC procedures:	See "Hydrologic (2012) ER calculations 2012-11-30 Verification" and " Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"
Purpose of data:	Baseline/ Project emission calculations
Calibration requirement:	<p>a) 20 liter buckets</p> <ol style="list-style-type: none"> a. Procedure: Bucket volumes are verified by checking the width of the opening and bottom of the bucket against the manufacturer's engineering specifications at a +/- 0.1 centimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test <p>b) Digital Scale</p> <ol style="list-style-type: none"> a. Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed

	<p>c) Digital Thermometer</p> <ol style="list-style-type: none"> a. Procedure: The thermometers are verified by checking that the maximum variation between thermometers at room temperature and room temperature after 5 minutes, and two readings at boiling temp (30 sec) and boiling temp (1 min) do not exceed a threshold of +/- 4 degrees Celsius. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed <p>d) Stopwatch</p> <ol style="list-style-type: none"> a. Procedure: Each stopwatch is timed against an online standard stopwatch and verified at an accuracy of +/- 2 seconds. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed <p>e) Measuring Tape</p> <ol style="list-style-type: none"> a. Procedure: Measuring tapes are verified by checking the measurement achieved when measuring the length of ISO certified A4 paper (297cm) at a +/- 1 millimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test <p>Also see "Hydrologic (2012) Calibration&Inventory" for equipment calibration requirements.</p>
Additional comment:	

Data / Parameter:	$W_{p,y,charcoal}$
Unit:	Tonnes
Description:	Amount of charcoal required to boil 1 litre of water in project scenario
Measured/ Calculated/ Default:	Measured/Calculated
Source of data:	Water Boiling Test and Baseline fuel mix
Value(s) of monitored parameter:	0.000006
Monitoring equipment:	<ol style="list-style-type: none"> a) 20 liter buckets (Each of the 13 research teams worked at 4 households each week requiring 1 bucket for every household or $13(4)(1) = 52$ buckets; the WBT was conducted directly after the WCFT at the same household, so buckets from the WCFT were used to save money) b) Digital Scale (Each of the 13 research teams required 1 scale. Field Supervisors (3) carried 1 spare scale each. Total 16 scales.) c) Digital Thermometer (Same as Digital Scale. 16 total.) d) Stopwatch (Same as digital scale. Total 16.) e) Measuring Tape (same as Digital Scale. 16 total. As WBT was conducted directly after the WCFT at the same household, the same measuring tapes used in the WCFT were used in the WBT) <p>Also see "Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"</p>
Measuring/ Reading/ Recording frequency:	Once before first verification.
Calculation method (if applicable):	The formula used to reach this figure is: $W_{Charcoal\ required\ to\ boil\ 1\ litre\ of\ water\ with\ traditional\ stove} * \%_{stove\ usage\ in\ baseline\ scenario} + W_{Charcoal\ required}$

	to boil 1 litre of water with improved.stove * % _{stove usage in baseline scenario} = $W_{b,y,charcoal}$
QA/QC procedures:	See "Hydrologic (2012) ER calculations 2012-11-30 Verification" and " Hydrologic (2012) Annex IV - WBT, Water Boiling Test Protocol 2012-06-08"
Purpose of data:	Baseline/ Project emission calculations
Calibration requirement:	<ul style="list-style-type: none"> a) 20 liter buckets <ul style="list-style-type: none"> a. Procedure: Bucket volumes are verified by checking the width of the opening and bottom of the bucket against the manufacturer's engineering specifications at a +/- 0.1 centimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test b) Digital Scale <ul style="list-style-type: none"> a. Procedure: The scales are verified by checking the reading for a standard weight at an accuracy of +/- 2 grams b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed c) Digital Thermometer <ul style="list-style-type: none"> a. Procedure: The thermometers are verified by checking that the maximum variation between thermometers at room temperature and room temperature after 5 minutes, and two readings at boiling temp (30 sec) and boiling temp (1 min) do not exceed a threshold of +/- 4 degrees Celsius. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed d) Stopwatch <ul style="list-style-type: none"> a. Procedure: Each stopwatch is timed against an online standard stopwatch and verified at an accuracy of +/- 2 seconds. b. Frequency: The calibration should be completed every time a new set of water boiling tests has to be performed e) Measuring Tape <ul style="list-style-type: none"> a. Procedure: Measuring tapes are verified by checking the measurement achieved when measuring the length of ISO certified A4 paper (297cm) at a +/- 1 millimeter threshold. b. Frequency: The calibration should be completed every two years before the Water Consumption Field is conducted and before a new Water Boiling Test <p>Also see "Hydrologic (2012) Calibration&Inventory" for equipment calibration requirements.</p>
Additional comment:	

3.1 Summary of data used for ER calculations

Table 1 - Summary of data used for ER calculations

Description	Parameter	Value	Unit
Wood consumption	$B_{b,y,wood}$	1.31	tonnes
Charcoal consumption	$B_{b,y,charcoal}$	0.04	tonnes

Number of person.days supplied by CWP	$N_{j,y}/N_{p,y}$	1,933.77	person.days
People drinking safe water without boiling it	C_j	0.026	fraction
Quantity of safe water consumed	$Q_{p,y}$	1.78	litres per person per day
Quantity of raw water boiled	$Q_{p,rawboil,y}$	1.40	litres per person per day
Quantity of safe water boiled	$Q_{p,cleanboil,y}$	0.011	litres per person per day
Wood required to boil 1 litre of water	$W_{b,y,wood}$	0.000218	tonnes
Charcoal required to boil 1 litre of water	$W_{b,y,charcoal}$	0.000006	tonnes
Quantity of wood consumed	$B_{p,y,wood}$	0.58	tonnes
Quantity of charcoal consumed	$B_{p,y,charcoal}$	0.02	tonnes
People using CWP	C_j	0.026	fraction
Baseline emissions for wood	$BE_{b,y,wood}$	1.78	tCO ₂ e
Project emissions for wood	$PE_{p,y,wood}$	0.79	tCO ₂ e
Baseline emissions for charcoal	$BE_{b,y,charcoal}$	0.05	tCO ₂ e
Project emissions for charcoal	$PE_{p,y,charcoal}$	0.02	tCO ₂ e
Non Renewable Biomass	$\int_{NRB,y}$	73.28%	
Net Calorific Value wood	$\frac{NCV_{b,wood}}{NCV_{p,wood}}$	0.015	TJ/ton
CO ₂ Emission Factor wood	$\frac{EF_{b,wood,CO_2}}{EF_{p,wood,CO_2}}$	112.00	tCO ₂
CH ₄ and N ₂ O Emission Factor for wood	$\frac{EF_{b,wood,nonCO_2}}{EF_{p,wood,nonCO_2}}$	8.69	tonnes
Baseline Emissions	$BE_{b,y}$	1.83	tCO ₂ e
Project Emissions	$PE_{p,y}$	0.81	tCO ₂ e
Usage rate	$U_{p,y}$	0.71	
Leakage	$LE_{p,y}$	0.014	tCO ₂ e
Emission Reductions per unit	ER_y	1.0019	tCO₂e

3.2 Summary of ER during the monitoring period

The overall GHG reductions are calculated as follows:

$$ER_y = (\sum BE_{b,y} - \sum PE_{p,y}) * U_{p,y} - \sum LE_{p,y}$$

Where:

$BE_{b,y}$ Emissions for baseline scenario b during the year y in tCO₂e

$PE_{p,y}$ Emissions for project scenario p during the year y in tCO₂e

$U_{p,y}$ Cumulative usage rate for technologies in project scenario p during year y, based on cumulative installation rate and drop off rate

$LE_{p,y}$ Leakage emissions for project scenario p during year y in tCO₂e

The excel version¹⁴ of the calculations is available at request.

Table 2 - Summary of VERs generated during the monitoring period

Summary of VERs generated during the monitoring period				
Year	Estimation of baseline emissions (tCO ₂ e)	Estimation of project activity emissions (tCO ₂ e)	Estimation of leakage (tCO ₂ e)	Estimation of overall emission reductions (tCO ₂ e)
May 2013 - Dec 2013	143,792	63,802	1,107	55,950
Jan 2014 - Apr 2014	93,840	41,638	722	36,513
Total emissions reduction	<i>237,632</i>	<i>105,440</i>	<i>1,829</i>	92,463

3.3 Comparison between PDD and monitoring data

The summary table below compares the data from the PDD and monitoring data and provides the respective justification.

Table 3 Summary of differences with PDD values

Description	PDD ¹⁵	01/12/20	01/06/20	01/05/20	Units	Remarks
		10– 31/05/20 12 ¹⁶	12– 30/04/20 13	13 – 30/04/20 14		
$B_{b,y,wood}$	1.36	1.36	1.36	1.31	tonnes	Wood consumption per unit has decreased slightly because the variables used in the calculations have been updated as per the WCFT (namely number

¹⁴ HSE HH MP3 ER Calculations

¹⁵ All values in this column are from "Hydrologic (2014) PDD - DESIGN CHANGE." Any and all reference sources can be found in this document.

¹⁶ All values in this column are from "Hydrologic - MR MP1 - 2012-12-06_CLEAN"

						of person.days per unit)
$B_{b,y,charcoal}$	0.04	0.04	0.04	0.04	tonnes	Charcoal consumption has decreased slightly because the variables used in the calculations have been updated as per the WCFT (namely the number of person.days per unit)
$N_{j,y}/N_{p,y}$	2,197.45	2,197.45	2,197.45	1,933.77	person .days	The number of person.days has decreased because the number of people per CWP drinking water has decreased from 6.02 pp/HH * 365 days = 2,197 to 5.30 pp/HH * 365 = 1,933
C_j	2.60%	2.60%	2.60%	2.60	%	No change – non-monitored
$Q_{p,y}$	1.46	1.45885	1.45885	1.78	litres per person per day	The required updated WCFT revealed higher water consumption than the previous field test.
$Q_{p,rawboil,y}$	1.45	1.45269	1.45269	1.40	litres per person per day	The required updated WCFT shows less boiling of raw water than the previous field test.
$Q_{p,cleanboil,y}$	0.01	0.01178	0.01178	0.011	litres per person per day	The required updated WCFT shows very similar amounts of filtered water that is subsequently boiled as previous field tests.
$W_{b,y,wood}$	0.000218	0.000218	0.000218	0.000218	tonnes	No change
$W_{b,y,charcoal}$	0.000006	0.000006	0.000006	0.000006	tonnes	No change
$B_{p,y,wood}$	0.68	0.68	0.68	0.58	tonnes	Wood consumption has decreased because the variables used in the calculations have been updated as per the WCFT (namely the number of person.days decreased)
$B_{p,y,charcoal}$	0.02	0.02	0.02	0.02	tonnes	No change
C_j	2.60%	2.60%	2.60%	2.60	%	No change
$BE_{b,y,wood}$	1.83	1.83	1.83	1.78	tCO2e	Wood consumption has decreased because he variables used in the

						calculations have been updated as per the WCFT (namely the number of person.days decreased)
$PE_{p,y,wood}$	0.92	0.92	0.92	0.79	tCO2e	Wood consumption has decreased because the variables used in the calculations have been updated as per the WCFT (namely the number of person.days and the amount of raw water still boiled has decreased)
$BE_{b,y,charcoal}$	0.10	0.10	0.10	0.05	tCO2e	As directed by the GoldStandard PP has adopted more conservative approach by considering parameters such as NCV and EF of wood for calculating $BE_{b,y,charcoal}$
$PE_{p,y,charcoal}$	0.05	0.05	0.05	0.02	tCO2e	As directed by the GoldStandard PP has adopted more conservative approach by considering parameters such as NCV and EF of wood for calculating $PE_{p,y,charcoal}$
$\int_{NRB,y}$	73.28	73.28	73.28	73.28	%	No change
$NCV_{b,wood}/NCV_{p,wood}$	0.015	0.015	0.015	0.015	TJ/ton	No change
$EF_{b,wood,CO2}/EF_{p,wood,CO2}$	112.00	112.00	112.00	112.00	tCO2	No change
$EF_{b,wood,nonCO2}/EF_{p,wood,nonCO2}$	7.54	7.54	7.54	8.69	tonnes	The nonCO2 emission factor has increased due to using the updated GWP for a 100 year lifetime.
$NCV_{b,charcoal}/NCV_{p,charcoal}$	0.0295	0.0295	0.0295	0.015	TJ/ton	As directed by the GoldStandard PP has adopted more conservative approach by considering NCV of wood for charcoal as well
$EF_{b,charcoal,CO2}/EF_{p,charcoal,CO2}$	112.00	112.00	112.00	112.00	tCO2	No change. However as directed by the GoldStandard, PP has

						adopted more conservative approach by considering EF of wood for charcoal as well
$EF_{b,charcoal,nonCO_2} / EF_{p,charcoal,nonCO_2}$	4.51	4.51	4.51	8.69	tonnes	The nonCO2 emission factor has increased due to using the updated GWP for a 100 year lifetime. As directed by the GoldStandard PP has adopted more conservative approach by considering values of wood for charcoal as well
$BE_{b,y}$	1.92	1.92	1.92	1.83	tCO2e	The Baseline Emission is now lower because the variables used in the calculations have been updated as per the WCFT (namely the number of person.days and the amount of raw water still boiled has decreased)
$PE_{p,y}$	0.97	0.97	0.97	0.81	tCO2e	The Project Emission is now lower because the variables used in the calculations have been updated as per the WCFT (namely the number of person.days and the amount of raw water still boiled has decreased)
$U_{p,y}$	100.00	100	100	0.71	%	The usage rate is monitored, and is lower because more units have been in use longer.
$LE_{p,y}$	0.01	0.012	0.017	0.014	tCO2e	Leakage calculations are based on the amount of wood at the factory and the number of units sold during the monitoring period, which changes in each monitoring period.
ER_y	0.95	0.94	0.94	1.0019	tCO2e	The Emission Reduction per unit is now higher because the WCFT has been updated, which has

						shown less boiling of raw water in the project scenario and an increase in the amount of water filtered per person, increasing the emission reduction achieved in the project scenario.
Total ER_y	94,448 ¹⁷	43,087	51,634	92,463	tCO ₂ e	The total number of credits for the crediting period is higher because more units were sold and the ERs per unit is slightly higher than estimated.
Units sold	46,248 ¹⁸	66,565	45,194	64,143	Units of Ceramic Water Purifiers	The demand for CWPs is higher than estimated at the beginning of the project and has resulted in more sales.

¹⁷ Annex 4 of the PDD estimates the monthly emission reductions over the crediting period. To arrive at estimated emission reductions over the current monitoring period, the PP has added together the emission reductions estimated in Annex 4.

¹⁸ Annex 4 of the PDD estimates average monthly sales at 3,854 CWPs. To arrive at estimated sales over the period the following calculations used: 3,854 CWPs per month * 12 months in the monitoring period = 46,248 CWPs over the monitoring period.

4 Monitoring co-benefits

4.1 Do No Harm assessment

Table 4 - Do No Harm assessment

Description of DNH	Monitoring
Human rights	As there is no risk of human rights issues, no action has been included to monitor this activity according to Hydrologic (2014) "Passport – DESIGN CHANGE".
Involuntary settlements	As there are no risk involuntary settlements caused by the project activity, no action to monitor this activity has been included in the document Hydrologic (2014) "Passport – DESIGN CHANGE".
Cultural heritage	As there is no risk of harm towards cultural heritage, no action to monitor this activity has been identified according to Hydrologic (2014) "Passport – DESIGN CHANGE".
Labor – collective bargaining and freedom of association. Has the project demonstrated that it will not limit freedom of association and right to collective bargaining more than required by law?	All staff signed a document titled "Right to Collective Bargaining and Freedom of Association" ¹⁹ acknowledging they understand this right. A scanned copy is available to the DOE.
Forced labor - Are employees free to quit their services without the menace of penalty? Are all employees offering their services on a voluntary basis?	All staff signed a document titled "Right to Collective Bargaining and Freedom of Association" ²⁰ acknowledging they understand this right. A scanned copy is available –to the DOE.
Child Labor - Does the project employ or intend to employ children below the age of 15 in regular work or hazardous work? Does the project employ or intend to employ children below the age of 18 in hazardous work?	Hydrologic does not employ anybody under 18 years old, therefore there is no risk of child labor working in hazardous conditions. All staff signed a document titled "Right to Collective Bargaining and Freedom of Association" ²¹ acknowledging they understand this issue. A scanned copy is available to the DOE.
Labor discrimination - Does the project's employment policy discriminate, exclude or prefer people based on race, colour, gender, religion, sexual orientation, political opinion, national	PP does not discriminate in any form. All staff signed a document titled "Anti-Labor Discrimination and Harassment Policy" ²² acknowledging they understand that discrimination has no place at

¹⁹ Hydrologic (2012) DNH Collective Bargaining & Freedom of Association English

²⁰ Hydrologic (2012) DNH Collective Bargaining & Freedom of Association English

²¹ Hydrologic (2012) DNH Collective Bargaining & Freedom of Association English

²² Hydrologic (2012) DNH Labor discrimination policy in English

extraction, social origin or physical or mental disability?	Hydrologic. A scanned copy is available in available to the DOE.
Labor safety - Has there been a credible and sufficient investigation to identify potential hazards for workers? Are workers exposed to hazardous chemicals or other material? Are workers involved in processes which are potentially dangerous? Have other hazardous been identified? Has the risk of sexual harassment and abuse of women been considered sufficiently? Is there an emergency action plan in the case of accidents for every site? Is there an insurance or pension system for workers in place in case of health impacts?	All potential hazards for workers have been assessed and measures have been put in place to reduce the risks. Trainings and close monitoring are in place to ensure safety measures are in place and used by all staff as per the document "Health and Safety Precaution". ²³ A scanned copy is available to the DOE.
Environmental harm	No risk of environmental harm has been identified and therefore no monitoring is required according to Hydrologic (2014) "Passport – DESIGN CHANGE".
Degradation of habitats	No risk of degradation of habitats has been identified and therefore monitoring is not required according to Hydrologic (2014) "Passport – DESIGN CHANGE".
Corruption Is the project known to employ practiced where entrusted power is abused for private gain?	All staff signed a document titled "Anti-Corruption Policy" ²⁴ acknowledging they understand that corruption has no place at Hydrologic. A scanned copy is available to the DOE.
Human Resources There should be a facility where employees can raise issues directly to their supervisors or to a dedicated HR person (outside the factory)	The contact details of the Human Resource department are provided to all staff in case they want to talk to somebody else other than their manager to discuss sensitive issues or complaint. This is available in the document titled "Code of Ethics." ²⁵ This is available to the DOE.

²³ Hydrologic (2012) DNH Health and Safety Precaution

²⁴ Hydrologic (2012) DNH, Anti-corruption policy in English

²⁵ Hydrologic (2012) DNH, Code of ethics in English

4.2 Sustainability matrix

Table 5 - Sustainability matrix

Description of Monitoring Sustainability Matrix																									
<p>Water Quality and quantity: Surveys and records of number of HHs/People served with the CWP units</p>	<p>As per HSE HH MP3 Water Consumption Field Test²⁶, the data shows 64,143 households have been served with an average of 5.30 persons, which is the equivalent of (64,143 * 5.30 persons = 339,957 more people served during the monitoring period.) The CWP removes at least 99.99% of E.Coli and Coliforms as shown in HSE HH MP3 Water Quality Test Reports.²⁷</p>																								
<p>Livelihood of the Poor: Project Survey and relevant academic reports or literature; fuel savings from kitchen performance tests multiplied by current market price for charcoal and wood (if purchased). The Project Survey will ask how people are using the time saved, this will be reported in the monitoring report. The price of the CWP will also be monitored.</p>	<p>1) As per the Project Survey in HSE HH MP3 Project Survey Report²⁸, the data collected shows the following the fuel saving and money savings extrapolation as per the table below:</p> <table border="1" data-bbox="544 745 1401 1167"> <thead> <tr> <th>Percent of fuel Purchased</th> <th>Percent of users who purchase this percent of fuel</th> <th>Annual saving if fuel purchased is wood</th> <th>Annual saving if fuel purchased is charcoal</th> </tr> </thead> <tbody> <tr> <td>100.0%</td> <td>14.2%</td> <td>\$ 35.88</td> <td>\$ 100.69</td> </tr> <tr> <td>75.0%</td> <td>1.6%</td> <td>\$ 26.91</td> <td>\$ 75.52</td> </tr> <tr> <td>50.0%</td> <td>0.8%</td> <td>\$ 17.94</td> <td>\$ 50.35</td> </tr> <tr> <td>25.0%</td> <td>9.2%</td> <td>\$ 8.97</td> <td>\$ 25.17</td> </tr> <tr> <td>0.0%</td> <td>74.3%</td> <td>\$ -</td> <td>\$ -</td> </tr> </tbody> </table> <p>2) 94.1% of respondents report spending less time collecting fuel after purchasing the Tunsai water filter, this time is mainly spent:</p> <ol style="list-style-type: none"> Working to make money (36.1%) Working around the home (42.4%) Relaxing (8.9%) With family (8.2%) Hobbies (3.2%) Other (2%) <p>3) The project survey revealed that 71% of those interviewed had purchased their filter. 90.8% reported that they had paid between US\$20 and US\$30 for their filters, which is in line with current pricing.</p>	Percent of fuel Purchased	Percent of users who purchase this percent of fuel	Annual saving if fuel purchased is wood	Annual saving if fuel purchased is charcoal	100.0%	14.2%	\$ 35.88	\$ 100.69	75.0%	1.6%	\$ 26.91	\$ 75.52	50.0%	0.8%	\$ 17.94	\$ 50.35	25.0%	9.2%	\$ 8.97	\$ 25.17	0.0%	74.3%	\$ -	\$ -
Percent of fuel Purchased	Percent of users who purchase this percent of fuel	Annual saving if fuel purchased is wood	Annual saving if fuel purchased is charcoal																						
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²⁶ HSE HH MP3 WCFT REPORT

²⁷ HSE HH MP3 WATER QUALITY TEST REPORTS

²⁸ HSE HH MP3 Project Survey Report

	The PP keeps track of the break-even price of CWPs to ensure that end users are buying a subsidized CWP compared to the real costs of the CWP as shown in the document “HSE HH MP3 Break Even Price”.
Quantitative employment and income generation: employment record	At the end of April, Hydrologic employed 172 staff, 61 of which are female: <ul style="list-style-type: none"> • 40 factory staff, 15 of which are female • 25 office staff, 7 of which are female • 107 field staff, 39 of which are female²⁹.

4.3 Stakeholder Consultation comments

Table 6 - Stakeholder Consultation comments received at Validation

Description of Sustainability Matrix	Monitoring
R&D expenditure (research needs to include a feasibility assessment to improve the quality of the water filters to remove viruses or chemicals)	R&D is an important part of Hydrologic's activities. Funding for research has been spent on: <ul style="list-style-type: none"> - Human Centered Design research for product design and dissemination strategy to introduce the CWP into Cambodian school classrooms - Product design of a school adapted CWP - Product design of a new low-cost basic CWP redesign
Research will take part to assess the feasibility to improve the quality of the water filters to remove more viruses and chemicals	Updated review on the feasibility of improving Hydrologic's product offering to address the treatment of viruses and chemical contamination ³⁰ .
PP will also report on the break-even price of the water filters sales price + 10% markup price if there is no finance	The break-even price + 10% markup price is available to DOE. ³¹
The retailers will be re-informed on water filter sales price + Hydrologic will remind periodically to the retailer the Manufacturer's Suggestion Retailer Price	Hydrologic has reminded the retailers the Suggested Retailer's Price to end users ³² .
Project Surveys will ask how much are people paying for the water filters and assess that the prices are not unreasonable. If the prices are unreasonable, PP shall investigate the reason and take appropriate action. PP believes that the risk is low because there are so many sales people that competition will keep prices low	Hydrologic has records of all the direct sales and which prices they were sold, as well as the CWPs sold through micro-finance. Many of the sales happen through NGOs which resale at a much lower price than they have purchased ³³ . So far all the prices sold are not unreasonable.

²⁹ HSE HH MP3 Employment Record and Income Generation

³⁰ HSE HH MP3 Feasibility Assessment to reduce viruses and chemicals

³¹ HSE HH MP3 Break Even Price

³² HSE HH MP3 Price of the Water Filters

³³ HSE HH MP3 Price of the Water Filters

Table 7 - Stakeholder Consultation comments received during MP3

Comment Received	PP Reply	PP Action (if required)
<p>I would like to congratulate you on the success of your Hydrologic project: we are at an earlier stage in the development of our project in Ethiopia, so your work is an inspiration for us.</p> <p>I was reviewing your updated webpage here. One thing caught my attention: you were able to convert your project from a Small Scale to Large Scale. This came as a welcome surprise to me: my understanding was that the Gold Standard only allowed clean water projects to be registered as small scale (independently of its size and number of emissions).</p> <p>So my question is: how were you able to convert the project? Could you have registered it as a large scale project in the first place? What are the formal Gold Standard criteria that allow you to choose this size to make the first registration? Is it only a quantitative evaluation of potential CO2 reduction or are there other criteria or restrictions that we need to consider to choose the correct size of a project?</p>	<p>Thank you for your interest in Hydrologic. To answer your questions, Hydrologic’s carbon project is registered under the Gold Standard Methodology for Technologies and Practices to Displace Decentralized Thermal Energy Consumption (http://www.goldstandard.org/wp-content/uploads/2011/10/GS_110411_TPDDTEC_Methodology.pdf), which allows for both large and small scale projects to be registered.</p> <p>Hydrologic initially registered as a small scale projects based on initial estimates for input parameters into the expected emissions reductions. Subsequently, actual values realized for some of those parameters (including quantity of wood used to boil water, amount of water consumed from each filter etc.) were higher. Hydrologic also far exceeded initial sales expectations. These changes meant that that the actual emissions reductions exceeded the cap imposed on credit issuance for small scale projects.</p> <p>Hydrologic thus made the decision to apply for a design change – which involved updating the Project Design Document (PDD) with the new information and re-registering as a large scale project. In all, for Hydrologic this was a relatively simple process, with the revised PDD being reviewed by the Gold Standard and approved following some small information requests and clarifications.</p> <p>For Hydrologic, the decision to change to a large scale project was based on emissions reduction potential and has had relatively minor effects on the overall project (these did include an additional fee payable to Gold Standard, and Hydrologic had to change DOE for the subsequent verifications, as the previous one had also validated the project – allowed for small scale but not large scale projects).</p> <p>Hope this answers your questions – please let me know if you would like any further information or have any other questions.</p> <p>Best of luck with your work in Ethiopia, would be great to hear how this progresses.³⁴</p>	<p>No action deemed necessary</p>

³⁴ HSE HH MP3 Question on Carbon credits

4.4 Conservativeness

The Project Survey³⁵ was used to collect the data about stove usage and fuel mix.

Table 8 Stove/Fuel Mix

	Improved Cookstove	Traditional Cook Stove	3 Stone	LPG	Electricity	Total fuel users	Percentage
	# HH	# HH	# HH	# HH	# HH		
Wood	14	61	1			76	90.5%
Charcoal	0	0	0			0	0.0%
Use both wood and charcoal	0	3	0			3	3.6%
LPG				5		5	6.0%
Electricity					0	0	0.0%
Total per stove category	14	64	1	5	0	84	100.0%
Percentage	16.7%	76.2%	1.2%	6.0%	0.0%	100%	
Non-Response						39	

The Baseline Survey³⁶ shows a higher use of improved cook stove (37%) compared to the Project Survey results as shown in the table above. If PP were to update the fuel mix based on the Project Survey numbers, it would be able to claim additional VERs, however PP choose to be conservative and use the fuel and stove mix from the baseline.

4.5 Quality Assurance and Quality Control

The project proponent is responsible for accurate and transparent record keeping, monitoring and evaluation. All supporting documentation and records for the project are easily accessible for spot checking and cross referencing by a third party.

The contact information in the project database³⁷ will allow a project auditor to easily contact and visit end users. Auditors will be able to cross reference pertinent project documentation, which will include archives such as production records financial accounts, and sales records, as well as invoices and sales performance.

³⁵ HSE HH MP3 Project Survey Report

³⁶ Hydrologic - Baseline study report 16-02-2012_final, p.6

³⁷ HSE HH MP3 Project Database JAN - MAY 2014
HSE HH Project Database DEC 2010 - DEC 2012

5 Timeline for dissemination of units

The project activity is implemented on a number of different locations and the units are distributed as the sales are completed. The table below shows when the units are distributed.

Table 9 - Summary of units distributed and tCO₂e

2013	May	4,978	100,684	15,324	6,799	71%	118	5,962
2013	Jun	4,195	105,662	16,081	7,135	71%	124	6,257
2013	Jul	3,522	109,857	16,720	7,419	71%	129	6,506
2013	Aug	7,567	113,379	17,256	7,657	71%	133	6,714
2013	Sep	4,135	120,946	18,407	8,168	71%	142	7,162
2013	Oct	4,322	125,081	19,037	8,447	71%	147	7,407
2013	Nov	10,373	129,403	19,694	8,739	71%	152	7,663
2013	Dec	7,484	139,776	21,273	9,439	71%	164	8,278
2014	Jan	4,151	147,260	22,412	9,945	71%	173	8,721
2014	Feb	5,186	151,411	23,044	10,225	71%	177	8,967
2014	Mar	4,709	156,597	23,833	10,575	71%	183	9,274
2014	Apr	3,521	161,306	24,550	10,893	71%	189	9,553