# Monitoring report form
# (Version 05.1)

*Complete this form in accordance with the Attachment "Instructions for filling out the monitoring report form" at the end of this form.*

| MONITORING REPORT | | |
|---|---|---|
| **Title of the project activity** | Efficient Fuel Wood Stoves for Nigeria | |
| **UNFCCC reference number of the project activity** | 2711 | |
| **Version number of the monitoring report** | 02 | |
| **Completion date of the monitoring report** | 14/11/2016 | |
| **Monitoring period number and duration of this monitoring period** | MP 04<br>01/07/2013 – 30/06/2014 | |
| **Project participant(s)** | Developmental Association for Renewable Energies<br>Atmosfair gGmbH<br>Lernen-Helfen-Leben e.V. | |
| **Host Party** | Nigeria | |
| **Sectoral scope(s)** | 3: Energy demand | |
| **Selected methodology(ies)** | AMS II.G., version 1 (EB37), "Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass" | |
| **Selected standardized baseline(s)** | Not applicable | |
| **Estimated amount of GHG emission reductions or net GHG removals by sinks for this monitoring period in the registered PDD** | 34,027 $tCO_2e$ | |
| **Total amount of GHG emission reductions or net GHG removals by sinks achieved in this monitoring period** | GHG emission reductions or net GHG removals by sinks reported up to 31 December 2012 | GHG emission reductions or net GHG removals by sinks reported from 1 January 2013 onwards |
| | 0 | 9,970 |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

>>

(a) Purpose of the project activity and the measures taken for GHG emission reductions or net anthropogenic GHG removals by sinks

The purpose of the project activity is the dissemination of up to 12,500 efficient fuel wood stoves (SAVE80) and heat retaining polypropylene boxes (hereafter referred to as the SAVE80 system) in different states located in the Guinea Savannah Zone of Nigeria, at subsidized prices.
Users are households who previously used inefficient, traditional fireplaces, consuming non-renewable biomass. The SAVE80 system saves up to 80% of fuel wood. By reducing the fuel wood consumption, the project activity hence reduces greenhouse gas emissions stemming from the use of non-renewable biomass.

(b) Brief description of the installed technology and equipment;

The SAVE80 is a portable stove made of stainless steel, developed and prefabricated by a German manufacturer and assembled locally to create employment and income. The initial model has a specified thermal efficiency of 52% and nominal effective thermal power of about 1.5 kW. As per specification of the manufacturer, the SAVE80 needs only about 250 g of small brittle sticks of wood to bring 6 litres of water to the boil, 80% less than traditional fire places. The design ensures preheating of the air and a complete combustion with no visible smoke and only small amounts of ash.
The SAVE80 system also consists of custom-fit pots, pans and a heat retaining box ('Wonderbox'), where food can be transferred after reaching the boiling temperature, and where it will continue to simmer until it is well cooked. The Wonderbox allows important energy savings in addition to the savings by the Save80.

(c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.)

| Date | Milestone |
|---|---|
| 01/04/2008 | Starting date of the project activity: First stove sales under CDM activity |
| 12/10/2009 | Registration with UNFCCC |
| 12/10/2009 – 30/06/2010 | First Monitoring Period |
| 01/07/2010 – 30/06/2012 | Second Monitoring Period |
| 01/07/2012 – 30/06/2013 | Third Monitoring Period |
| 01/07/2013 – 30/06/2014 | Fourth Monitoring Period |

(d) Total GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period.

9,970 t $CO_2e$

### A.2. Location of project activity

>>

(a) Host Party:
Federal Republic of Nigeria

(b) Region/ State/ Province:

The project activity is located in the states belonging to the Guinea Savannah Zone of Nigeria:

The following states mainly belong to the Guinea Savannah Zone:

a. Benue
b. Enugu
c. Kaduna
d. Kogi
e. Kwara
f. Nasarawa
g. Niger
h. Oyo
i. Plateau
j. Taraba
k. Federal Capital Territory (FCT)

(c) City/ Town/ Community:
The SAVE80 systems were installed in households in the Guinea Savannah Zone.

(d) Physical/ Geographical location:

In the registered PDD, the coordinates of DARE's former main office in 97/98 Kachia Road, Kaduna, were used to represent the physical location of the project activity:

Latitude: 10.476944 degree
Longitude: 7.419444 degree

Please note: DARE moved to other premises located at KM 38, Kaduna-Zaria Expressway (after JAJI Military Cantonement), Sabon Yelwa - Kaduna State

The coordinates are:

Latitude: 10.866425 degree
Longitude: 7.614297 degree

## A.3. Parties and project participant(s)

| Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Indicate whether the Party involved wishes to be considered as project participant (yes/no) |
|---|---|---|
| Nigeria (host) | Developmental Association for Renewable Energies (private entity) | No |
| Germany | 1. Atmosfair gGmbH (Private entity)<br>2. Lernen-Helfen-Leben e.V. (private entity) | No |
| … | … | |

## A.4. Reference of applied methodology and standardized baseline

>>
AMS II.G., version 1 (EB37), "Energy Efficiency Measures in Thermal Applications of Non-Renewable Biomass"

### A.5. Crediting period of project activity

>>
Fixed crediting period (10 years)
Start of crediting period: 12/10/2009
End of crediting period: 11/10/2019

### A.6. Contact information of responsible persons/entities

>>
Katrin Mikolajewski
Tel: +49 (0) 30 627 3550-16
Email: mikolajewski@atmosfair.de
Atmosfair gGmbH
Zossener Strasse 55 -58
10961 Berlin, Germany

## SECTION B. Implementation of project activity

### B.1. Description of implemented registered project activity

>>
(a) Description of the installed technology, technical processes and equipment

The SAVE80 is a portable stove made of stainless steel, developed and prefabricated by a German manufacturer and assembled locally to create employment and income. The initial model has a specified thermal efficiency of 52% and nominal effective thermal power of about 1.5 kW. As per specification of the manufacturer, the SAVE80 needs only about 250 g of small brittle sticks of wood to bring 6 litres of water to the boil, 80% less than traditional fire places. The design ensures preheating of the air and a complete combustion with no visible smoke and only small amounts of ash. The SAVE80 system also consists of custom-fit pots, pans and a heat retaining box ('Wonderbox'), where food can be transferred after reaching the boiling temperature, and where it will continue to simmer until it is well cooked. The Wonderbox allows important energy savings in addition to the savings by the Save80. However, these energy savings will not be taken into account for calculating emission reductions which is increasing the overall conservativeness of the Emission Reduction calculations.

(b) Information on the implementation and actual operation of the project activity, including relevant dates (e.g. construction, commissioning, continued operation periods, etc.).

The following table lists the number of SAVE80 systems deployed under the project activity since the starting date of the project activity on 01/04/2008 and as recorded in the database at the end of the monitoring period. Please note: Not all SAVE80 systems that were sold until the end of the respective Monitoring Period were yet recorded in the database. Hence deployment figures in the subsequent monitoring reports may slightly vary.

| Year | ICS deployed |
|---|---|
| 2008 (01/04 – 31/12) | 346 |
| 2009 | 804 |
| 2010 | 1390 |
| 2011 | 2721 |
| 2012 | 106 |
| 2013 | 1 |
| 2014 | 2 |
| **Total** | **5,370** |

Note: Each SAVE80 system starts to generate emission reductions in the month following the delivery of the SAVE80 system.

Project implementation is

| | |
|---|---|
| Ahead of the schedule described in Section A.2 of the PDD | ☐ |
| As described in Section A.2 of the PDD | ☐ |
| Behind the schedule described in Section A.2 of the PDD | ☑ |

Explanation:

After March 2012 no more stoves are distributed under this SSC project. Still not all shipped stoves were recorded in the database at the end of the monitoring period.

(c) Description of:

(i) The events or situations that occurred during the monitoring period that may impact the applicability of the applied methodology;

No special events which may impact the applicability of the methodology occurred.

(ii) How the issues resulting from these events or situations have been addressed.

Not applicable

## B.2. Post-registration changes

### B.2.1. Temporary deviations from registered monitoring plan, applied methodology or applied standardized baseline

>>

According to request for clarification on monitoring and verification in conflict zones (INQ-Q4074-EB) we applied for contingency measures for monitoring and verification. The exception is valid until the 27th of November 2018. See for more details section C.

### B.2.2. Corrections

>>

During the last monitoring period a Post Registration Change for correcting:

a) The location of the project activity
b) Clarification related to length of monitoring period and duration of vintage
c) Editorial correction from $t_{j,i}$ to $t_{y,j}$

Has been submitted to the UNFCCC. The submission date was the 19th of June 2013.

The correction and the revised PDD were approved after the End of this monitoring period. The approval date of the Post Registration Changes was the 8th of November 2013. The PRC reference number is: PRC-2711-001
(https://cdm.unfccc.int/PRCContainer/DB/prcp445244817/view)

### B.2.3. Changes to start date of crediting period

>>

No changes to the start date of the crediting period have been approved during this monitoring period or submitted with this monitoring report.

### B.2.4. Inclusion of a monitoring plan to the registered PDD that was not included at registration

>>

No inclusion of a monitoring plan to the registered PDD have been approved.

### B.2.5. Permanent changes from registered monitoring plan, applied methodology or applied standardized baseline

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No permanent changes from the registered monitoring plan or applied methodologies have been approved during this monitoring period or submitted with this monitoring report.

### B.2.6. Changes to project design of registered project activity

>>

No changes to the project design of the project activity have been approved during this monitoring period or submitted with this monitoring report.

### B.2.7. Types of changes specific to afforestation or reforestation project activity

>>

Not applicable.

## SECTION C. Description of monitoring system

>>

According to request for clarification on monitoring and verification in conflict zones (INQ-Q4074-EB) we applied for contingency measures for monitoring and verification. In agreement with the DoE the monitoring consists of:

| Parameter | Data Source(s) |
|---|---|
| Number of SAVE80 systems in use ($N_{y,i}$) | 1. Purchase Contracts<br>2. Project Database Records<br>3. Spot Checks to User Households |
| Operation time of the SAVE80 ($t_{y,j}$) | Project Database Records |
| Efficiency of the SAVE80 ($\eta_{new,i}$) | Water Boiling Test |

Based on the political situation in Nigeria the UN approved an exception that the verification was performed together with the monitoring and that the amount of on-site visits of the households was reduced from 25 to 8. The exception is valid until the 27$^{th}$ of November 2018.

*Number of SAVE 80 systems in use and operation time of the SAVE80*

- Users who wished to obtain a SAVE80 system under the CDM project 2711 signed a purchase contract, which contained their contact details, serial number (Cooker-ID) of the SAVE80 stove delivered, and the contract / delivery date.
- User contact information, Cooker-ID, contract and delivery date was regularly transferred to an electronic database (“Project database”).

- The project database was used for calculation of number of systems delivered and recorded in the database as per end of the 4th monitoring period on 30/06/2014, and for random selection of households for the spot checks for monitoring period 4, 01/07/2013 – 30/06/2014.
- Spot Checks to User Households were conducted in at least
- 100 households. 8 households have been visited and the rest have been contacted via phone.
- Drop-Out rate (i.e. households found not to use the SAVE80 during the spot checks) was calculated and standard error added as per requirement of the PDD.
- The number of SAVE80 systems as recorded in the project database was multiplied with the drop-out rate + standard error determined for the monitoring period and adjusted for the operational time[1] to derive the parameter $N_{y,i}$ (Number of SAVE80 systems in use during the specified period)

* Note: not all users who obtained a SAVE80 stove during the monitoring period are contained in the databases used, due to administrative reasons. The users not yet recorded in the database do not count for calculation of emission reductions in this monitoring period; however, they may be added to the database later and hence count in the subsequent monitoring periods.

*Efficiency of the SAVE 80. Water Boiling Test*

- Efficiency Tests (Water Boiling Tests) were conducted during the presence of an experienced researcher as required by the PDD. Three SAVE80 cookers of the 1st vintage were tested. The SAVE80 cookers were obtained from frequent users that are using the SAVE80 at least 2-3 times a day.
- Data was recorded manually and thereafter entered into an electronic data sheet and cross-checked with manufacturer specifications and literature values.
- The mean values of the efficiency tests were calculated by atmosfair and multiplied with the conservativeness factor as in the registered PDD.

**Organizational structure, roles and responsibilities of personnel**

The following persons were in charge to conduct monitoring tasks during the fourth Monitoring Period.

| Organisation | Name | Role as defined in the PDD | Responsibility/Tasks |
|---|---|---|---|
| DARE | Yahaya Ahmed | DARE CDM Monitoring Officer (DARE-MO) | - Supervision of purchase contracts and project database recording<br>- Supervision of Efficiency Testing and Spot Checks<br>- Review of Monitoring Report |
| LHL | Bernd Blaschke | Assigned Monitoring Officer (LHL-MO) | - Efficiency Tests Data Assessment<br>- Project Database Records Assessment<br>- Preparation and Review of |

[1] The operation time of a SAVE80 system is a simple calculation of months a SAVE 80 system generated emission reductions within the monitoring period divided by months of the year, to take into account that the Monitoring Period may be less than a year, or the systems start to generate emission reductions within a Monitoring period. According to the PDD, each SAVE80 system starts to generate emission reductions in the month following delivery of the SAVE80 system, to account for delays between purchase and first use. The operation time is hence the number of months during the Monitoring period where the system generated emission reductions, divided by the number of months of a year.

| | | | |
|---|---|---|---|
| | | | Monitoring Report |
| Atmosfair | Katrin Wolf | Assigned Monitoring Officer (atm-MO) | - Data Quality Control<br>- CER calculation and Preparation of Monitoring Report |

**Emergency procedures for the monitoring system**

There is a separation of roles for every step of the data generation, aggregation & recording, calculation and reporting between those who are responsible and those who are controlling the respective step.
In particular, the DARE CDM monitoring officer checked correctness and consistency between information on the purchase contracts and the corresponding database record. If the Monitoring Officer detected inconsistencies, he instructed his team to search for the error source. If the error source could be found, the information was corrected accordingly, if not, the database record was removed from the database and did not count for this monitoring period.
The atmosfair Monitoring Officer was responsible for overall data control, i.e. checked again correctness and consistency of all data collected and processed in this Monitoring Period. This included, inter alia, a cross-check if the database record for a given stove-ID is in line with the information on the purchase contract, and if the equations and calculations of the efficiency test are correct and plausible.

**Procedures for tracking of changes of ownerships and/or relocations of SAVE80 systems**
Procedures for tracking of changes of ownership and/or relocations of SAVE80 systems have been implemented to address FAR Q1 of the first verification. In the monitoring spot checks, the monitoring team checked whether the contact details are still correct, and if not recorded the new contact details. From these new contact details it could be determined whether the SAVE80 systems are outside of the project boundary. These systems were counted as drop outs.

## SECTION D. Data and parameters

### D.1. Data and parameters fixed ex ante or at renewal of crediting period

*(Copy this table for each piece of data and parameter)*

| **Data/parameter:** | $B_{y,appliance}$ |
|---|---|
| Unit | tonnes/year |
| Description | Quantity of Biomass used in the absence of the project activity (per appliance) |
| Source of data | Baseline Survey |
| Value(s) applied) | 4.6534 |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | |

| **Data/parameter:** | $L_y$ |
|---|---|
| Unit | fraction |
| Description | Leakage Correction Factor |

| | |
|---|---|
| Source of data | Derived from Leakage Assessment |
| Value(s) applied) | 0.99 |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | As per AMS II.G., v1, if leakage has to be considered then $B_y$ is adjusted to account for the quantified leakage. Therefore, the Leakage Correction Factor $L_y$ is applied to the project activity, and leakage emissions are already considered in the baseline emissions calculation. |

| **Data/parameter:** | $\eta_{old}$ |
|---|---|
| Unit | Fraction |
| Description | Efficiency of the system being replaced |
| Source of data | Water-Boiling Test |
| Value(s) applied) | 0.1 |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | |

| **Data/parameter:** | $f_{NRB, y}$ |
|---|---|
| Unit | Fraction |
| Description | Fraction of non-renewable biomass saved by the project activity |
| Source of data | FAO (2003): Experience of Implementing National Forestry Programmes in Nigeria (see ftp://ftp.fao.org/docrep/fao/005/AC918E/AC918E00.pdf) |
| Value(s) applied) | 0.77 |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | |

| **Data/parameter:** | $NCV_{biomass}$ |
|---|---|
| Unit | TJ/t |
| Description | Net calorific value of non-renewable biomass that is substituted |
| Source of data | IPCC default value for fuel wood |
| Value(s) applied) | 0.015 TJ/tonne |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | |

| **Data/parameter:** | $EF_{projected\ fossil\ fuel}$ |
|---|---|
| Unit | t $CO_2$/TJ |

| | |
|---|---|
| Description | Emission factor for the substitution of non-renewable biomass by similar consumers |
| Source of data | IPCC default value for Kerosene |
| Value(s) applied) | 71.5 t $CO_2$/TJ |
| Choice of data or measurement methods and procedures | |
| Purpose of data | Baseline emission calculation |
| Additional comments | |

## D.2. Data and parameters monitored

*(Copy this table for each piece of data and parameter)*

| **Data/parameter:** | **$N_{y,i}$** |
|---|---|
| Unit | Number |
| Description | Number of SAVE80 systems in use per vintage<br>The first vintage consists of all SAVE80 systems sold since the project start date until the end of the first monitoring period, the second vintage of all SAVE80 systems sold during the second monitoring period, the third vintages of all SAVE80 systems sold during the third monitoring period, and so forth. |
| Measured/calculated/default | Calculated |
| Source of data | Purchase Contracts, Project Database records, Monitoring spot checks |
| Value(s) of monitored parameter | Vintage 1: 12/10/2009 – 30/06/2010: 1,385.02<br>Vintage 2: 01/07/2010 – 30/06/2011: 1,1174.04<br>Vintage 3: 01/07/2011 – 30/06/2012: 1,091.69<br>Vintage 4: 01/07/2012 – 30/06/2013: 2.04<br>Vintage 5: 01/07/2013 – 30/06/2014: 0.91<br><br>Total $N_{y,i}$ = 3,653.71 |
| Monitoring equipment | Monitoring consisted of data recording in an electronic database. Sales of the SAVE80 systems were recorded. The user signed a purchase contract, where the date, the name of the user and contact details (if available) are noted to doubtlessly identify the user. Every SAVE80 cooker has an identification number (Cooker-ID) which was also noted on the purchase contract. The information from the purchase contract was transferred to the electronic database. |
| Measuring/reading/recording frequency: | Purchaser Contracts/ Project Database: Continuous recording frequency<br>Spot Checks: annually |
| Calculation method (if applicable): | $N_{y,i} = \sum_{j=1}^{Ny.i} n_{y,j} \cdot t_{y,j}$<br>Where<br>$n_{y,j}$ Appliance operating per year and vintage (adjusted for Drop-Outs incl. Standard Error)<br><br>$t_{y,j}$ Fraction of operation time per SAVE80 system per vintage (months/months per year) (see monitoring parameter below) |

| | |
|---|---|
| QA/QC procedures: | Database entries were made by staff from DARE. They were supervised by the DARE CDM Monitoring Officer assigned by DARE, LHL and atmosfair.<br>The database records and copies of the purchase contracts were transferred to Germany. LHL and atmosfair cross-checked the database entries with the purchase contracts.<br>To check if the information in the database was correct and the SAVE80 systems are still operating, spot checks were conducted in the monitoring period.<br>Conservative approach:<br>To the share of households that were found not to use the SAVE80 in the Monitoring Sample group, the Standard Error was added.<br>By multiplication with the total number of SAVE80 systems in use per vintage, the number of households that do not use the SAVE80 system per vintage was determined and was deducted from the number of appliances delivered per vintage. |
| Purpose of data: | Baseline emission calculation |
| Additional comments: | |

| **Data/parameter:** | $t_{y,j}$ |
|---|---|
| Unit | fraction |
| Description | Operation time per SAVE80 system per vintage (months of the Monitoring Period/months per year). |
| Measured/calculated/default | Calculated |
| Source of data | Project Database records |
| Value(s) of monitored parameter | MP 4: 01/07/2013 – 30/06/2014<br><br>Three Save80 systems included in the project have been sold after June 2013 (one in November 2013, one in January 2014 and one in February 2014). Thus $t_{y,j}$ =1 for all deployed systems in vintage 1-4 and $t_{y,j}$ =0.44 for deployed systems in vintage 5. |
| Monitoring equipment | Not applicable |
| Measuring/reading/recording frequency: | To be conservative every SAVE80 system started to generate emission reductions in the month following delivery of the SAVE80 system, to account for delays between purchase and first use. |
| Calculation method (if applicable): | $t_{y,j}$ = months system was operating within the Monitoring Period/months per year |
| QA/QC procedures: | Not applicable |
| Purpose of data: | Baseline emission calculation |
| Additional comments: | |

| Delivery time | Vintage | Operational time $t_{y,j}$ |
|---|---|---|
| 12/10/2009 – 30/06/2010 | 1 | 1.00 |
| 01/07/2010 – 30/06/2011 | 2 | 1.00 |
| 01/07/2011 – 30/06/2012 | 3 | 1.00 |
| 01/07/2012 – 30/06/2013 | 4 | 1.00 |
| 01/07/2013 – 30/06/2014 | 5 | 0.44 |

| **Data/parameter:** | $\eta_{new,i}$ |
|---|---|
| Unit | fraction |
| Description | Efficiency of the SAVE80 system for each vintage |
| Measured/calculated/default | Measured |

Source of data

Water Boiling Tests were conducted on 21/05/2010, 05/07/2011, 09/08/2012, 16-17/04/2014 and 04.-08/07/2016, during the monitoring campaigns which are usually conducted after the end of the respective monitoring period.
To measure the efficiency of the SAVE80, the Water Boiling Test, as described under Section B.4 of the registered PDD, is conducted. 3 SAVE80 cookers from the first vintage, i.e. sold since the project start date until the end of the first monitoring period are tested in each monitoring campaign.
The test results are always multiplied by a conservativeness factor of 0.943 as determined in the registered PDD, to account for uncertainties.
For clarity, in line with the registered monitoring plan, the following source of data are to be used to determine the efficiency:

| Monitoring period | Vintage | Value used |
|---|---|---|
| | 1st vintage:<br>All SAVE80 cookers sold since the project start date until the end date for the first monitoring campaign (= Monitoring period 1) | Efficiency value used:<br>From efficiency testing during monitoring for Monitoring period 4 (tests conducted 04.-08/07/2016) |
| | 2nd vintage:<br>All SAVE80 cookers sold after end date for the first monitoring campaign until the end date for the second monitoring campaign (= Monitoring period 2, Part 1) | Efficiency value used:<br>From efficiency testing during monitoring for Monitoring period 3 (tests conducted 16.-17/04/2014) |
| | 3rd vintage:<br>All SAVE80 cookers sold after end date for the second monitoring campaign until the end date for the third monitoring campaign<br>(= Monitoring period 2, Part 2) | Efficiency value used:<br>From efficiency testing in Monitoring Period 2. Part 1 (test conducted on 09/08/2012) |
| | 4th vintage:<br>All SAVE80 cookers sold after end date for the third monitoring campaign until the end date for the fourth monitoring campaign (= Monitoring period 3) | Efficiency value used:<br>From efficiency testing in Monitoring period 2, Part 2 (test conducted on 05/07/2011) |
| | 5th vintage:<br>All SAVE80 cookers sold after end date for the fourth monitoring campaign until the end date for the fifth monitoring campaign (= Monitoring period 4) | Efficiency value used:<br>From efficiency testing in Monitoring campaign 1 (i.e. value from first monitoring period, test conducted on 21/05/2010) |

| | | |
|---|---|---|
| Vintage i=1 | **32,68%** | Efficiency Tests SSC Fourth Monitoring Period |
| Vintage i=2 | **33.33%** | Efficiency Tests SSC Third Monitoring Period |
| Vintage i=3 | **40.97%** | Efficiency Tests SSC Second Monitoring Period Part 2 |
| Vintage i=4 | **41.11%** | Efficiency Tests SSC Second Monitoring Period Part 1 |
| Vintage i=5 | **35.19%** | Efficiency Tests SSC First Monitoring Period |

The efficiency applied in Monitoring Period 4 was calculated as the weighted average efficiencies of operational stoves per vintage during the monitoring period.

| | |
|---|---|
| Value(s) of monitored parameter | 35.37% weighted average MP 4 |

**Monitoring equipment**

| | Weighing Scale |
|---|---|
| Type | KD 8000 |
| Accuracy class | +/- 1 g |

| | Thermocouple |
|---|---|
| Type | Greisinger Präzisionsthermometer GMH 3710 |
| Temperature range | -199.99° C - +199.99° C |

**Measuring/reading/recording frequency:**

Once per monitoring period

**Calculation method (if applicable):**

To determine the efficiency of one stove, the mean value of the three tests per stove were taken, multiplied by a conservativeness factor of 0.943 as determined in the registered PDD, to account for uncertainties.

To determine the efficiency of stoves from the tested vintage the average of the three tested stoves was calculated.

Efficiency of stoves from the tested vintage (1):

$\eta_{new,i} = 1/3 * [(\eta_{new,1,1} + \eta_{new,1,2} + \eta_{new,1,3})/3 + (\eta_{new,2,1} + \eta_{new,2,2} + \eta_{new,2,3})/3 + (\eta_{new,3,1} + \eta_{new,3,2} + \eta_{new,3,3})/3)] * 0.943$

To calculate the efficiency of the monitoring period, the calculated stove efficiency of each vintage i, was multiplied with the share of operational stoves[2] belonging to the vintage:

The sum of so-obtained values for all vintages is the weighted average.

$=N_{y,1}(\text{in }\%)* \eta_{new,1} + N_{y,2}(\text{in }\%)* \eta_{new,2} + N_{y,3}(\text{in }\%)* \eta_{new,3} + N_{y,4}(\text{in }\%)* \eta_{new,4}$

| vintage i | $N_{y,i}$ | $N_{y,i}$ (%) | Efficiency ηnew,i |
|---|---|---|---|
| i=1 | 1385,03 | 38% | 32.68% |
| i=2 | 1174,04 | 32% | 33.33% |
| i=3 | 1091,69 | 30% | 40.97% |
| i=4 | 2,04 | 0% | 41.11% |
| i=5 | 0,91 | 0% | 35.19% |
| **Weighted average efficiency** | | | **35.37%** |

**QA/QC procedures:**

The tests were supervised by the DARE CDM Monitoring Officer. An instruction for the efficiency test was provided by LHL and atmosfair. The tests were carried out in the presence of an experienced researcher.
Results from the tests were cross-checked with literature values and specifications from the manufacturer of the SAVE80 and values were found to be reasonable.

Conservative approach:
Test results were multiplied by a conservativeness factor of 0.943 to account for bias uncertainty.

**Purpose of data:**

Baseline emission calculation

**Additional comments:**

## D.3. Implementation of sampling plan

>>

[2] Operational stoves per vintage divided by total number of operational stoves in the specific monitoring campaign of the monitoring period

Please note that at time the project activity was registered (12/10/2009), the sampling standard (EB 65 Annex 2) was not yet adopted, neither were the sampling guidelines (EB 69 Annex 5). Therefore, the monitoring plan of the registered PDD does not contain a sampling plan.
Nonetheless, since data and parameters monitored which are described in section D.2 above are determined by a sampling approach, a description is provided on how the sampling efforts and surveys for those data and parameters were implemented.

(a) Description of implemented sampling design;

Simple Random Sampling was applied in accordance with the registered PDD.
The Monitoring Sample was selected via a computerized randomizer in the project database (cut-off date 25/07/2014), which selected households for the spot checks. The selected households were contacted either by phone or by physical inspection. In line with the registered PDD, the required number of households for each of the annual check was 1% of the population or at least 100: *"To check if the information in the database is correct and the SAVE80 systems are still operating, annual spot checks will be conducted. […]. Therefore, the spot checks will cover at least 1% of all households, at least 100."*
Therefore, the sample size is determined based on all the households, i.e. the total population which is 5,370 for monitoring period 4. 1% of 5,370= 53.70 which is less than the 100 required by the PDD. Therefore, the sample consisted of 100 households. Additionally, we applied oversampling as per EB 67 Annex 6, para 30 to compensate for, outliers or non-response associated with the sample. We assumed 60% response rate, based on the experiences from former Monitoring Periods. A total sample of 170 households was drawn from the project database.

The monitoring team undertook the monitoring of the parameters determined via sampling. Monitoring of the parameter $DO_y$ to calculate $N_{y,i}$ was done by phone interviews or personal interviews of stove users using a common Questionnaire. In the questionnaire the stove user was asked if their stove is in use. The answer is either "yes" or "no". If the answer is "no" the stove is counted as "drop-out" ($DO_y$). The percentage of drop-outs is used to adjust the total number of stoves in the database, since $N_{y,i}$. is defined as number of SAVE80 systems in use.

After the monitoring team contacted all of the households on the list, not all could be interviewed. Therefore we drew a second "Replacement sample" of 50 additional households. The replacement sample is a random sample from the project database, where we excluded the households which were already selected in the first sample (total stoves included in the database for sampling: 5,370 – 170 = 5,200). The computerized randomizer was used to select the replacement sample. From the replacement sample all the households were contacted.

In total we interviewed 105 households, which is more than the required sample size of 100 households.

For the determination of $\eta_{new}$, the efficiencies of three stoves from the first vintage were tested using the water boiling test. Each of the 3 stoves was tested 3 times. The water boiling test was conducted as required in the PDD under the supervision of an experienced researcher. The test results were noted manually on a data entry form and later transferred into the efficiency calculation sheets. To determine stove efficiency the average of the 3 tests per stove was calculated and multiplied by a conservativeness factor (CF) of 0.943. To obtain the $\eta_{new,1}$ for vintage-1-stoves the average of the three tested stove efficiencies was calculated.

(b) Collected data, analysis of the same and demonstration on whether the confidence/precision has been met

The methodology (AMS II.G. ver. 1) does not stipulate any confidence/precision criteria which need to be met. The PDD however requires that the standard error is added to the Drop Out Rate.

Monitoring Period 4: 01/07/2013 – 30/06/2014:

| Parameter | n* | Value | Standard error |
|---|---|---|---|
| Drop Out | 105 | 27.62% | 4.32% |
| $\eta_{new,1}$ ($\eta_{new,1}$ including CF of 0.943) | 9 | 34.66% (32.68%) | 0.0434 |

*valid responses
For further details please refer to the CER calculation spreadsheet.

## SECTION E. Calculation of emission reductions or GHG removals by sinks

### E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

>>

Please note that the methodology ASM II.G., v1 does not provide specific equations for calculation of Baseline emissions, project emissions or leakage, only for Emission reductions. As Leakage was considered ex-ante, $B_y$ was adjusted to account for the quantified leakage. Therefore, the Leakage Correction Factor $L_y$ was applied to the project activity.

The Emission reductions calculations as per the AMS II.G., v1 and as stated in the registered PDD is as follows (for each monitoring campaign of the monitoring period, i.e. there is a separate calculation for monitoring campaign 2 and monitoring campaign 3):

$$ER_y = B_{y,savings} \cdot f_{NRB,y} \cdot NCV_{biomass} \cdot EF_{projected\_fossilfue}$$

Where:

| | |
|---|---|
| $ER_y$ | Emission reductions during the year in t $CO_2e$ |
| $B_{y,savings}$ | Quantity of biomass that is saved in tonnes |
| $f_{NRB,y}$ | Fraction of biomass saved by the project activity in year y that can be established as non-renewable biomass using survey methods |
| $NCV_{biomass}$ | Net calorific value of non-renewable biomass that is substituted (IPCC default value for fuel wood 0.015 TJ/tonne, i.e. 15 MJ/kg wood) |
| $EF_{projected\_fossilfuel}$ | Emission factor for the substitution of non-renewable biomass by similar consumers |

Calculation of Biomass Savings ($B_{y,savings}$):

$$B_{y,savings} = \sum_{i=1}^{n} B_{yadjusted i} \cdot (1 - \frac{\eta_{old}}{\eta_{new,i}})$$

$$= \sum_{i=1}^{n} B_{yappliance} \cdot L_y \cdot N_{y,i} \cdot (1 - \frac{\eta_{old}}{\eta_{new,i}})$$

Where:

| | |
|---|---|
| $B_{y,adjusted,i}$ | Adjusted quantity of biomass used in the absence of the project activity (tonnes/year/vintage) |
| $B_{y,appliance}$ | Average annual biomass consumption per appliance (tonnes/year) (remains fixed throughout the crediting period) |
| $L_y$ | Leakage Correction Factor (remains fixed throughout the crediting period) |
| $N_{y,i}$ | Number of appliances operating per year and vintage |
| $\eta_{old}$ | Efficiency of the system being replaced, measured using representative sampling methods or based on referenced literature values (fraction) (remains fixed throughout the crediting period) |
| $\eta_{new,i}$ | Efficiency of the system |

Number of appliances operating per year ($N_{y,i}$):

$$N_{y,i} = \sum_{i=1}^{Ny,i} n_{y,i} \cdot t_{y,i}$$

Where:

| | |
|---|---|
| $n_{y,j}$ | Appliance operating per year and vintage |
| $t_{y,j}$ | Fraction of operation time per SAVE80 system per vintage (months/months per year) |

Total Emission Reductions for this Monitoring Period are summarised in the table below:

| **Parameter** | **Unit** | **Value** |
|---|---|---|
| $B_{yappliance}$ | t/a | 4.6534 |
| $L_y$ | | 0.99 |
| $N_{y,i}$ | | 3,653.71 |
| $B_{yadjusted,i}$ | t | 16,832.16 |
| $\eta_{old}$ | | 0.1 |
| $\eta_{new,i}$ | | 0.354 |
| $B_{y,savings}$ | t | 12,073.48 |
| $f_{NRB,\ y}$ | | 0.77 |
| $NCV_{biomass\ (TJ7t)}$ | TJ/t | 0.015 |
| $EF_{projected\ fossil\ fuel}$ | t $CO_2$/TJ | 71.5 |
| **$ER_y$ (monitoring period 3)** | **t $CO_2$e** | **9,970.58** |

Note:
$N_{y,i}$ ("stove-years") is calculated by summing up the number of appliances operating / in use ($n_{y,j}$, i.e. number of systems delivered adjusted for drop-outs and Standard error) multiplied with their operational time $t_{y,j}$. Please refer to the CER calculation spreadsheet.

### E.2. Calculation of project emissions or actual net GHG removals by sinks

>>

Not applicable, as methodology ASM II.G., ver. 1 does not consider project emissions.

### E.3. Calculation of leakage

>>

Leakage Correction Factor Ly as determined ex-ante and stated in the registered PDD was applied to the project activity to calculate Emission Reductions of this Monitoring Period.

### E.4. Summary of calculation of emission reductions or net GHG removals by sinks

| Item | Baseline emissions or baseline net GHG removals by sinks (t $CO_2e$) | Project emissions or actual net GHG removals by sinks (t $CO_2e$) | Leakage (t $CO_2e$) | GHG emission reductions or net GHG removals by sinks (t $CO_2e$) achieved in the monitoring period | | |
|---|---|---|---|---|---|---|
| | | | | Up to 31/12/2012 | From 01/01/2013 | Total amount |
| **Total** | 9,970 | Not applicable | Not applicable | 0 | 9,970 | 9,970 |

### E.5. Comparison of actual emission reductions or net GHG removals by sinks with estimates in registered PDD

| Item | Values estimated in ex ante calculation of registered PDD | Actual values achieved during this monitoring period |
|---|---|---|
| Emission reductions or GHG removals by sinks (t $CO_2e$) | 34,027 | 9,970 |

### E.6. Remarks on difference from estimated value in registered PDD

>>

Estimates in the PDD for the period covered under this Monitoring Report were as follows:

The actual values achieved during this monitoring period are lower than estimated in the PDD. The reason is that compared to the estimates in the PDD,

- the number of appliances (SAVE 80 system) were less (see Section B.1) than originally planned
- no drop-outs were assumed in the ex-ante calculation.

Hence the CER generated in the monitoring period is less than estimated value in registered PDD.

# Appendix 1. Contact information of project participants and responsible persons/entities

| | |
|---|---|
| **Project participant and/or responsible person/ entity** | ☒ Project participant<br>☒ Responsible person/ entity for completing the CDM-MR-FORM |
| **Organization name** | Atmosfair gGmbH |
| **Street/P.O. Box** | Zossener Strasse 55 |
| **Building** | Aufgang Strasse , 1.OG |
| **City** | Berlin |
| **State/region** | Berlin |
| **Postcode** | 10961 |
| **Country** | Germany |
| **Telephone** | + 49 (0) 30 627 3550 -0 |
| **Fax** | +49 (0) 30 627 3550 -29 |
| **E-mail** | info@atmosfair.de |
| **Website** | www.atmosfair.de |
| **Contact person** | Nele Erdmann |
| **Title** | Project Manager |
| **Salutation** | |
| **Last name** | Erdmann |
| **Middle name** | |
| **First name** | Nele |
| **Department** | CDM Project developer |
| **Mobile** | |
| **Direct fax** | +49 (0) 30 627 3550 -29 |
| **Direct tel.** | + 49 (0) 30 627 3550 -16 |
| **Personal e-mail** | erdmann@atmosfair.de |

| | |
|---|---|
| **Project participant and/or responsible person/ entity** | ☒ Project participant<br>☐ Responsible person/ entity for completing the CDM-MR-FORM |
| **Organization name** | Development Association for Renewable Energies |
| **Street/P.O. Box** | 97/98 Kachia Road |
| **Building** | |
| **City** | Kaduna |
| **State/region** | Kaduna State |
| **Postcode** | |
| **Country** | Nigeria |
| **Telephone** | +234-8033110130 |
| **Fax** | |
| **E-mail** | dare@dareworld.org |
| **Website** | www.dareworld.org |
| **Contact person** | Yahaya Ahmed |
| **Title** | Chairman |

| | |
|---|---|
| **Salutation** | |
| **Last name** | Ahmed |
| **Middle name** | |
| **First name** | Yahaya |
| **Department** | |
| **Mobile** | +234-8084424356 |
| **Direct fax** | |
| **Direct tel.** | |
| **Personal e-mail** | yahaya@gmx.de |

| | |
|---|---|
| **Project participant and/or responsible person/ entity** | ☒ Project participant<br>☐ Responsible person/ entity for completing the CDM-MR-FORM |
| **Organization name** | Lernen Helfen Leben e.V. |
| **Street/P.O. Box** | Achtern Diek 12 |
| **Building** | |
| **City** | Vechta |
| **State/region** | |
| **Postcode** | 49377 |
| **Country** | Germany |
| **Telephone** | |
| **Fax** | |
| **E-mail** | |
| **Website** | |
| **Contact person** | Paul Kraemer |
| **Title** | Board Member |
| **Salutation** | Dr. |
| **Last name** | Kraemer |
| **Middle name** | |
| **First name** | Paul |
| **Department** | |
| **Mobile** | |
| **Direct fax** | |
| **Direct tel.** | +49 2921-80523 |
| **Personal e-mail** | P.Kraemer.Soest@t-online.de |