**Monitoring Report**

###### PUBLICATION DATE **14.10.2020** VERSION **v. 1.1** RELATED SUPPORT – [**TEMPLATE GUIDE Monitoring Report v. 1.1**](https://globalgoals.goldstandard.org/standards/TGuide-PerfCert_V1.1-Monitoring-Report.pdf)

This document contains the following Sections

Key Project Information

SECTION A - Description of project

SECTION B - Implementation of project

SECTION C - Description of monitoring system applied by the project

SECTION D - Data and parameters

SECTION E - Calculation of SDG Impacts

SECTION F - Safeguards Reporting

SECTION G - Stakeholder inputs and legal disputes

### KEY PROJECT INFORMATION

##### Programme of Activity Information – (delete below table if N/A)

|  |  |
| --- | --- |
| **GS ID of Programme** | GS1172 (PoA) |
| **Title of Programme** | Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172) |
| **Version of POA-DD applicable to this monitoring report** | Version 7.0 |
| **Name and GS ID of fully Validated CPA/VPAs (i.e. non compliance check)** | Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172), VPA-2 (GS 5303) |

##### Key Project Information

|  |  |
| --- | --- |
| **GS ID (s) of Project (s)** | (GS 5303) |
| **Title of the project (s) covered by monitoring report** | Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172), VPA-2 (GS 5303) |
| **Version number of the PDD/VPA-DD (s) applicable to this monitoring report** | Version 1.4 |
| **Version number of the monitoring report** | Version 0.5 |
| **Completion date of the monitoring report** | 01/11/2022 |
| **Date of project design certification** | 04/05/2017 |
| **Date of Last Annual Report** | Not applicable |
| **Monitoring period number** | MP5 CP1 |
| **Duration of this monitoring period** | 01/01/2021 to 31/12/2021 (inclusive of both dates) |
| **Project Representative** | YRE |
| **Host Country** | Indonesia |
| **Activity Requirements applied** | Community Services Activities  Renewable Energy Activities  Land Use and Forestry Activities/Risks & Capacities  N/A |
| **Methodology (ies) applied and version number** | Technologies and practices to displace decentralized thermal energy consumption v.1.0 (11/04/2011) |
| **Product Requirements applied** | GHG Emissions Reduction & Sequestration  Renewable Energy Label  N/A |

##### Table 1 - Sustainable Development Contributions Achieved

|  |  |  |  |
| --- | --- | --- | --- |
| Sustainable Development Goals Targeted | SDG Impact | Amount Achieved | Units/ Products |
| **SDG 13: Climate Action** | - | **14,804** | VER |
| **SDG 7: Affordable and Clean Energy** | GS-08 Access to affordable and clean energy services | **1,582**  **6,266** | Biodigesters installed during MP5 (between 01/01/2021 and 31/12/2021)  Total biodigesters installed under the VPA until 31/12/2021 |
|  | GS-12 Technology transfer and technological self-reliance | **867** | Users attending training during this MP5 |
| **SDG 5: Gender Equality** | GS-09 Human and institutional capacity | **304** | Women attending Operation and Maintenance training during MP5 |
|  | GS-14 Time saved | **5,862** | Women reporting to have saved time during MP5 |
|  | GS-15 Productive use of time | **2,023** | Women reporting to have more time for productive use during MP5 |
| **SDG 2: No Hunger** | GS-03 Soil condition | **4,290** | Households using bio-slurry on land during MP5 |
|  | GS-13 Establishment of sustainable food production area | **122.20** | Hectares applying bio-slurry, per month during MP5 |
| **SDG 1: No Poverty** | GS-06 Quality of employment | **12** | Vocational trainings conducted during MP5 |
|  | GS-07 Livelihood of the poor | **79**  **2,459**  **3,728** | ‘Worsened’ during MP5  ‘The same’ during MP5  ‘Improved’ during MP5 |
|  | GS-10 Quantitative employment and income generation | **162**  **63**  **0** | Number of direct jobs created by the VPA during MP5  Number of constructors employed under the VPA during MP5  Households selling bio-slurry during MP5 |

##### Table 2 – Product Vintages

|  |  |  |  |
| --- | --- | --- | --- |
|  | | **Amount Achieved** | |
| **Start Dates** | **End Dates** | **VER** | **SDG achievements** |
| 01/01/2021 | 31/12/2021 | **14,804** |  |
| 01/01/2021 | 31/12/2021 |  | **SDG 7: Affordable and Clean Energy:**  **1,582** Biodigesters installed  **867** users attended training |
| 01/01/2021 | 31/12/2021 |  | **SDG 5: Gender Equality:**  **304** women attended operation and maintenance training  **5,862** women reported saving time  **2,023** women reported having more time for productive uses |
| 01/01/2021 | 31/12/2021 |  | **SDG 2: No Hunger:**  **4,290 h**ouseholds using bio-slurry on land during  **122.20** hectares applying bio-slurry, per month for sustainable food production |
| 01/01/2021 | 31/12/2021 |  | **SDG 1: No Poverty:**  **12** vocational trainings conducted  **162** direct jobs created  **63** constructors employed  **0** households reported selling bio-slurry during  **3,728** users reported their livelihood improved  **2,459** users reported their livelihood remained the same  **79** users reported their livelihood worsened |

1. DESCRIPTION OF PROJECT
   1. General description of project

>>

The Indonesia Domestic Biogas Programme (IDBP) is a development programme managed and implemented by Hivos (Humanist Institute for Co-operation with Developing Countries) in partnership with Yayasan Rumah Energy (YRE) and national support from the Directorate General of New Renewable Energy and Energy Conservation. The overall development objective of the IDBP is to disseminate domestic biodigesters as a local, sustainable energy source through the development of a commercial, market-oriented sector in selected Indonesian provinces. Biodigesters are fed with a mixture of water and animal manure that is anaerobically digested. The generated biogas is intended for use as fuel for cooking. The biodigester type implemented is the fixed-dome type, constructed with bricks and stone masonry.

The VPA-2 started implementation of biodigesters on 02/01/2017, following the filling of the VPA-1 which ended on 31/12/2016. The overall development objective of the VPA-2, and the IDBP programme which manages it, is to disseminate domestic biodigesters as a local, sustainable energy source through the development of a commercial, market-oriented sector in selected Indonesian provinces.

The monitoring period covered in this Monitoring Report is 01/01/2021 - 31/12/2021, which is the fifth monitoring period of the first crediting period running from 02/01/2017 – 01/01/2024.

* 1. Location of project

>>

The project is located in the Indonesian provinces shown below.

****

Table 2: Project location by provinces in Indonesia and GPS coordinates of provincial capitals

|  |  |  |
| --- | --- | --- |
| **Province** | **Latitude** | **Longitude** |
| Lampung | 5° 27' 0.0000'' S | 105° 16' 0.0120'' E |
| West Java | 6° 54' 53.0784'' S | 107° 36' 35.3160'' E |
| Central Java | 7° 47' 49.4448'' S | 110° 22' 13.9044'' E |
| East Java | ‎7° 15' 1.6020'' S | 112° 46' 7.8420'' E |
| Bali | 8° 24' 34.2648'' S | 115° 11' 20.1084'' E |
| Nusa Tenggara Barat | 8° 39' 10.5602" S | 117° 21' 41.9314" E |
| Nusa Tenggara Timur | 8° 39' 26.575" S | 121° 4' 45.732" E |
| Yogyakarta | 7° 47' 49.4448'' S | 110° 22' 13.9044'' E |
| South Sulawesi | 5° 8' 51.5940'' S | 119° 25' 57.8352'' E |

Provinces Banten and Sumatera Selatan are included in the West Java province

Province Kalimantan Tengah, Gorontalo, Central Sulawesi and Southeast Sulawesi is included in South Sulawesi province

* 1. Reference of applied methodology

>>

Technologies and Practices to Displace Decentralized Thermal Energy Consumption v.1.0 (11/04/2011).

Guidance, of the General Guidelines for Sampling and Surveys for Small-Scale CDM Project Activities (EB 50 Report, Annex 30)

IPCC Guidelines for National Greenhouse Gas Inventories (2006)

Requirements and Guidelines for carrying out usage surveys for projects implementing improved cooking devices (Annex 10)

* 1. Crediting period of project

>>

The project applies a renewable crediting period of 7 years running between 02/01/2017 – 01/01/2024 (including both days). This Monitoring Report covers the fifth monitoring period of the first crediting period, and covers GHG emission reductions generated in the period between 01/01/2021 - 31/12/2021.

1. IMPLEMENTATION OF PROJECT
   1. Description of implemented project

>>

The IDBP started implementation of biodigesters on 24/10/2009, following an agreement reached between the Royal Netherlands Embassy to support the Indonesian Ministry of Energy and Mineral Resources in rolling out a national biodigester initiative. A first Voluntary Project Activity (VPA-1) was retroactively included to cover the emission reductions that have been generated up to two years prior to the registration date of this PoA, which occurred on 31/05/2013. YRE is the official project representative of the IDBP PoA and the VPA implementer. In February 2021, YRE and Hivos signed MoU to transfer the facility management, disbursement and MRV from Hivos to YRE. It also stated Hivos transfers the full responsibility for the management of Carbon Fund, ownership of the VER and MRV of the PoA and VPAs to YRE. And in January 2022, Hivos sent a letter to Gold Standard to inform about the handover of CME function from Hivos to YRE with the supporting document: Cover Letter signed by Hivos and YRE. In Feb 2022, Gold Standard has confirmed the changes in the registry accounts of IDBP.

The second VPA (VPA-2) targets the same programme and includes biogas digesters installed from 02/01/2017 onwards. The inclusion of a second VPA into the registered PoA was needed due to VPA-1 reaching its small-scale methodology threshold limit as defined under the CDM. As such, VPA-2 represents a continuation of the existing IDBP programme, and does not differ in terms of target geographical area, technology type, or end-user type. One Post Registration Design Change was adopted for VPA-2 by the Gold Standard on 21/07/2020 to allow for the inclusion of biodigesters smaller than 4m3, as well as of a new type: plastic bag.

The next table shows the units built and commissioned in the period from 02/01/2017 to 31/12/2021 in the VPA-2.

**Table 3: Total Number of units installed by month and cumulative, VPA-2[[1]](#footnote-1)**

|  |  |  |
| --- | --- | --- |
| **Period** | **Number of biodigesters in VPA-2** | **Cumulative number of biodigesters in VPA-2** |
| 02/01/2017 – 31/12/2017 | 2,040 | 2,040 |
| 01/01/2018 – 31/12/2018 | 1,454 | 3,494 |
| 01/01/2019 – 31/12/2019 | 776 | 4,270 |
| 01/01/2020 – 31/12/2020 | 414 | 4,684 |
| 01/01/2021 – 31/12/2021 | 1,582 | 6,266 |
|  |  | **Total:** **6,266** |

In total **6,266**biodigesters were constructed as of 31/12/2021 in the VPA-2 project boundary.

Table 4 shows the distribution of the biodigesters across the nine targeted provinces.

**Table 4: Distribution of biodigesters per province, until 31/12/2021 [[2]](#footnote-2)**

|  |  |
| --- | --- |
| **Province** | **Number of biodigesters** |
| Lampung | 170 |
| West Java | 290 |
| Central Java | 230 |
| East Java | 958 |
| Bali | 258 |
| Nusa Tenggara Barat | 2,041 |
| Nusa Tenggara Timur | 470 |
| Yogyakarta | 964 |
| South Sulawesi | 885 |
| **Total:** | **6,266** |

The figure below shows the cumulative number of installed biodigesters as well as the number of units that are installed each month.

**Figure 1: Cumulative and monthly number of units installed until 31/12/2021**

Figure 1 shows that the cumulative number of units installed is steadily increasing, and that there is a small seasonal difference in the implementation effort.

The VPA-2 installs eight different biodigester sizes, with the 3m3, 2m3 and 1m3 plastic bag units being added in this MP as a result of a Post Registration Design Change; the figure below shows the proportions of each biodigester size expressed in fraction of total number of digesters built during the assessed period:

**Figure 2: Biodigester capacities implemented in VPA-2 (as per 31/12/2021) [[3]](#footnote-3)**

The most proliferated digester has a volume of 4 m3, followed by the 6 m3; according to the IDBP database. Other digester sizes are built to a much smaller extent, with the 8 m3, 10 m3 and 12 m3 joining totaling around 10% of all the digesters built. The average digester size built has a volume of 4.26 m3.[[4]](#footnote-4) The VPA-2 has a cumulative digester volume of 26,702 m3.[[5]](#footnote-5)

The VPA-2 meets the small-scale VPAs thresholds set forth by the CDM i.e., (45 MWth) for the renewable energy component and an emissions cap of 60,000 tCO2e for the methane avoidance component. The average biodigester size implemented in this VPA-2 is 4.26 m3. As per the calculation presented in footnote 8 below, this biodigester size requires daily feeding of (4.26 m3 \* 7.5 kg =) 31.950 kg of manure, equivalent to 1.28 m3 of biogas per day. As per the Table below, this amounts to a maximum output of 1.36 kWth, which is below the established threshold of 150 kWth per unit. Also, given 6,622 units implemented to date under the VPA-2, this cumulates to 8.512 MWth, below the 45 MWth threshold.

The calculation is presented below:

**Table 5: Calculation of total capacity under VPA-2**

|  |  |  |
| --- | --- | --- |
|  | | |
| Where: | Value: | Comments: |
| t = hours/day usage | 2.74 | See “Crosstab BUS by Province\_18May2016.xls”, sheet “raw\_data” cell J2683. Fixed for future verifications[[6]](#footnote-6) |
| η = efficiency of stove | 50% | Indonesian Government standard on stove efficiency |
| Hb = heat of combustion per unit volume of biogas | 21.0 MJ/m3 [[7]](#footnote-7) | Derived from IPCC defaults |
| Vb = volume of biogas | 1.46 m3/day[[8]](#footnote-8) | Data provided by Hivos |
| **E** = Energy available from the biogas system | 15.37 MJ/day[[9]](#footnote-9) | Calculated |
| **Eth =** | 4.27 kWh/day | 1 MJ = 0.2778 kWh |
| **Thcap =** | 1.56 kWth | Given a 2.74 hour/day usage |
| **Total capacity** | 8.512 MWth[[10]](#footnote-10) | Given 6,266 units installed |

As each biodigester produces a maximum emission reduction of 2.355 tCO2e from methane avoidance[[11]](#footnote-11), given 6,266 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 14,755 tCO2e. This is below the methodological threshold of 60,000 tCO2e.

* + 1. Forward Action Requests

>>

Not applicable.

* 1. Post-Design Certification changes

>>

* + 1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

>>

No post-registration design changes have been implemented for VPA-2.

* + 1. Corrections

>>

Not applicable.

* + 1. Changes to start date of crediting period

>>

Not applicable.

* + 1. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

>>

Not applicable.

* + 1. Changes to project design of approved project

>>

A design change approved by the GS on 21/07/2020 was introduced in this MP.

The programme explicitly allows for the inclusion of two types of biogas systems: (i) a fixed dome digester made from bricks and cement; and (ii) a plastic digester. All biogas digesters implemented under VPA-1 of the PoA were fixed dome digesters. VPA-2 of the PoA commenced operations (start date 02/01/2017) with implementing the fixed dome digester as well, but meanwhile the programme has developed a new biodigester type made from plastic (poly-ethylene) to cater for demands from potential users. This new biodigester model is called “bio-miru”, and has been tested and approved by the IDBP programme.

While biodigesters made from plastic are allowed under the PoA, the VPA-2 DD originally did not explicitly mention the eligibility of plastic digesters. Furthermore, the VPA-2 originally also specified that the capacity of the biodigesters ranges from 4 m3 to 12 m3. In order to both allow for VPA-2 to include i) plastic digesters; and ii) capacity sizes below 4 m3, a PRC was requested. As a result of this approved PRC (approved on 21/07/2020), this Monitoring Report now includes also the emission reductions generated by plastic digesters. Also, smaller capacities of units have also been added in this MP, including 1 m3, 2m3, and 3m3 units (please see Figure 2 in the Section B.1).

1. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

>>

1. **Organisational Setup of the carbon and SDG monitoring**

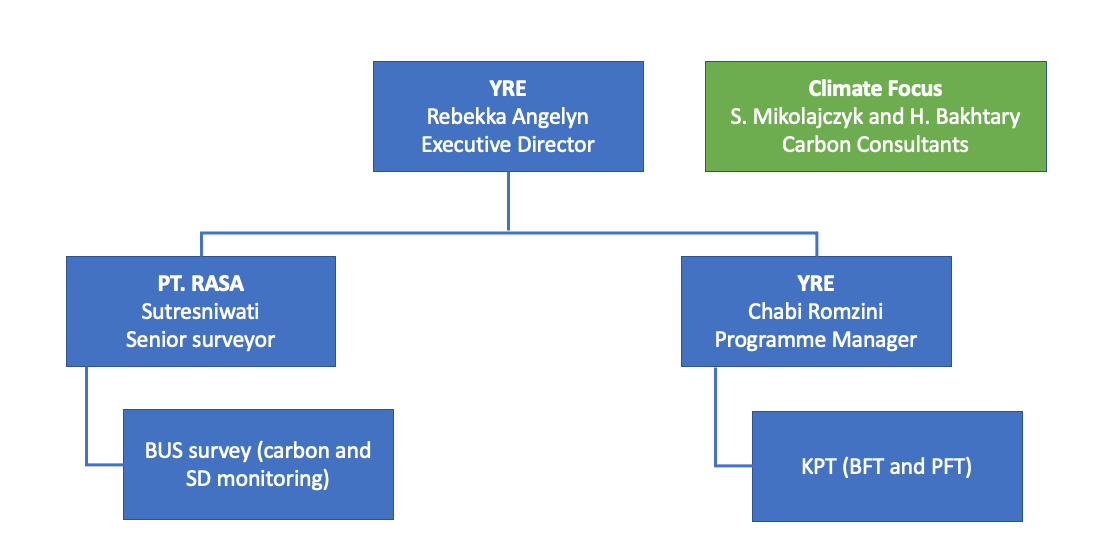
All monitoring was coordinated by YRE. The objective of the monitoring effort conducted under this VPA-2 was to meet the monitoring requirements set forth in the methodology Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011).

YRE appointed Ms. Sutresniwati from PT. RASA to conduct the Biogas User Survey, which serves as the monitoring survey under the VPA-2 (BUS 2021). The survey was designed and implemented in accordance with the requirements set forth in the methodology, whereby the selected sample size follows at least a 90% confidence interval and a 10% margin of error (90/10) requirements. Mr. Szymon Mikolajczyk and Mr. Haseeb Bakhtary from Climate Focus were placed in charge of advising PT. RASA on the VPA specific monitoring procedures. PT. RASA recruited 13 surveyors and 2 supervisors for the enumeration. All these surveyors received training on survey and data collection techniques and they were supervised by the Project Leader during survey implementation. Office training was conducted on December 17th 2021; meanwhile field training was conducted on December 18th. Data tabulation, analysis and reporting was prepared by PT. RASA.

YRE internally designed and implemented the KPT in December 2021 and January 2022, which was supervised by Ms. Chabi Romzini and supported by Mr. Szymon Mikolajczyk. Data collection for the KPT was conducted by PT. RASA, employing an experienced team (also responsible to carry out the Biogas User Survey). Tabulation and analysis of results was conducted by Mr. Szymon Mikolajczyk and Mr. Haseeb Bakhtary.

As per registered VPA-DD and GS PoA Transition Annex a number of monitoring activities were undertaken for this monitoring period. The monitoring surveys that were executed and the entities involved are shown in the next figure:

Figure 3: Surveys executed and entities involved



In terms of data monitoring, IDBP has two dedicated staff to monitor all data into the IDBP Database that submitted to the National Office.[[12]](#footnote-12) These Database Officers ensures the data are complete and correct from all CPOs. Recently in 2019 IDBP has improved its data efficiency management by applying Kobo Collect App where all CPOs submitted their data through this application, then using 3G connection the app will send the data to the main server in Jakarta. Two Database Officers regularly check and verify all submissions before submitting confirmation to Finance for any payment release. Quality Inspectors in the provinces also have access to Kobo to monitor their CPO’s progress.[[13]](#footnote-13)

YRE, based on the hard copies of the Household Agreement, is responsible for entering data into the centralised record-keeping database. It is YRE’s responsibility to ensure that data is entered correctly and to follow-up with the supplier where errors or missing data appeared.

Only the National Office can carry out payments to the CPOs. All sales records are sent to the National Office in the form of electronic files while the hard copies are stored in the provincial offices.

1. **Description of human resources**

**Rebekka Angelyn:** Rebekka is the Executive Director of YRE. Rebekka is in charge of supervise IDBP Program Manager who coordinates with provincial staffs on daily basis to provide updates about any occurring issues, implementation progress and working relations with partners.

**Sutresniwati:** Sutresniwati is in charge of running operations at PT. RASA, a surveyor company operating in Indonesia. PT. RASA delivers two types of services since 2015: field research, training and coaching. For field researches, PT. RASA focus to serve clients who need assessment, baseline survey, gender sensitive study and impact assessment as well as project evaluation. PT. RASA has been in charge of implementing and analysis the BUS, KPT and Leakage Assessment 2022.

**Chabi Romzini:** Chabi works as IDBP Program Manager in YRE. Chabi was responsible for the preparation of the KPT (BFT and PFT) that was implemented in December 2021. Chabi also responsible for overseeing all data entry process into the IDBP database. This includes updating implementation figures on a monthly basis, tracking the operational rate of installed biodigesters and tracking CPO and user trainings, among others.

**Szymon Mikolajczyk and Haseeb Bakhtary:** The key responsible persons for the preparation of this Monitoring Report. Szymon and Haseeb were selected consultants based on a tendering process conducted by YRE. Mr. S. Mikolajczyk has been involved with the IDBP since 2010 and assisted the IDBP through the Gold Standard validation, registration and first eight verifications process of VPA-2.

1. **Survey design**

The next table summarizes the design of the surveys:

**Table 6: Survey designs summary (data for VPA-2 only)**

|  |  |  |  |
| --- | --- | --- | --- |
| **Item** | **BUS 2021 (US + CMS)** | **KPT (PFT) [[14]](#footnote-14)** | **KPT (BFT)** |
| **Target group** | Households with a biodigester that has been in use for at least 6 months for each age group | Users with a biodigester | Households without a biodigester |
| **Main topics** | Drop-off rate, user characteristics, fuel usage and SDG impacts | Project fuel use | Baseline fuel use |
| **Sampling method** | Cluster sampling[[15]](#footnote-15) based on year of use, and multi-stage sampling[[16]](#footnote-16) to account for population size per province | Simple random sampling | Simple random sampling using PFT sampling frame |
| **Cluster** | Age group | N/A | N/A |
| **Cluster size** | 31 - 34 households[[17]](#footnote-17) | N/A | N/A |
| **Number of clusters** | 4 cluster is relevant to this MR | N/A | N/A |
| **Total sample size** | **158** | **93** | **39** |

1. **Biogas user survey (US + CMS)**

The Biogas User Survey (BUS) is the survey implemented under the VPA-2 annually that includes both the a) User Survey (US) and b) the Carbon Monitoring Survey (CMS). The survey was executed in 29th December 2021 - 25th January 2022 (referred to in this document as “BUS 2021”) amongst a representative sample of biodigester households with the objective to obtain reliable and unbiased data on the user characteristics, impact on the Sustainable Development Goals (SDG), on GHG emission modalities such as fossil and fuel wood consumption, cattle types and amounts. Furthermore, the usage parameter (in some programmes assessed in a separate user survey) has also been included in the BUS 2021. This parameter must be established to account for drop off rates as project technologies age and are replaced. Prior to the verification, a usage parameter is required that is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario.

The next table shows the studies included in the BUS 2021.

**Table 7: BUS studies**

|  |  |  |  |
| --- | --- | --- | --- |
| **#** | **Name of study** | **Monitoring interval** | **Conversion in MP5** |
| 1 | Project non-renewable biomass (NRB) assessment; | Once for the first crediting period | fNRB is established once for the entire first crediting period of VPA-2. |
| 2 | Project studies (PS) of target population characteristics; | Annual | Included in BUS 2021 |
| 3 | Monitoring of the SDG parameters. | Annual | Included in BUS 2021 |
| 4 | Leakage emission assessment | Every two years after first verification | Investigated alongside BUS 2021 |
| 5 | Maintenance of total sale record and project database | Continuous | Continuous activity |

**1. NRB Assessment**

Over the course of a project activity the project proponent may at any time choose to re-examine renewability by conducting a new NRB assessment. In case of a renewal of the crediting period and as per Gold Standard rules, the NRB fraction must be reassessed as any other baseline parameters and updated in line with most recent data available. Since this Monitoring Report still covers the first crediting period of VPA-2, the PP refers to the fNRB of 64.8% as per the PDD.

**2. Project survey (PS) of the target population characteristic**

In addition to the parameters monitored as per VPA-DD and GS Transition Annex, the BUS survey includes a set of target population parameters, such as household size, digester size, ID code.

**3. Sustainability assessment**

The BUS survey includes the monitoring of the SDG parameters where it applies to biogas households. Section D details the results of the SDG monitoring and the sources of data used.

**4. Leakage emission assessment**

A leakage investigation has been conducted (once every two years). Physical leakage is also included in the calculations.

**5. Maintenance of total sale record and project database**

All data sale records are collected and stored in a central database that is continuously updated. Excerpts of this database will be made available in the excel workbook belonging to this report.

**BUS Survey and Usage Survey design**

In December 2021 – January 2022, the surveys were executed by a team of surveyors from IDBP. The BUS 2021 monitoring procedure applied consisted of the following steps:

1. Details of the biogas households of each age group were gathered;
2. Random selection of at least 30 households from each age group, proportional to the overall population size of the province (multi-stage sampling). Sample selection in accordance to age groups was applied to the BUS as this survey also covers part of the Usage Survey, which needs to be arranged by age group. The sampling was executed using a web based random number generator.[[18]](#footnote-18) The sample size for each province was determined based on the biodigester user populations derived from the IDBP database to ensure representativeness.
3. IDBP staff surveyed the sampled households, and the gathered data was entered into a database at the head office following a data quality check.

To establish the sample size and the sample distribution, guidance from the applied Gold Standard methodology was applied relating to both the Carbon Monitoring Survey (i.e. minimum of 100 households for group size > 1,000) and the Usage Survey (i.e. at least 30 households per age group). As per the guidance, to ensure conservativeness, participants in a user survey with technologies in the first year of use must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use, the user survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on. For the VPA-2, the BUS approached a sample of **158** households. This exceeds the 5 age groups \* 30 households = 150 households minimum threshold. The Usage Survey was fully included in the BUS.

For the BUS 2021, biogas users classified as the 5th year of use are those who have been using an IDBP biodigester in the first year of VPA-2 (i.e. implementation between 02/01/2017 to 30/06/2017); as 4th year as the second year of the VPA-2 (i.e. implementation between 01/07/2017 to 30/06/2018); and as 3rd year as the third year of the VPA-2 (i.e. implementation between 01/07/2019 to 30/06/2019), and as 2nd year of the VPA-2 (i.e. implementation between 01/07/2020 to 30/06/2020, and as 1st year as the most recent year of the VPA-2 (i.e. implementation between 01/07/2020 to 30/12/2021)

The BUS 2021 covered all nine provinces that have become intervention areas of the VPA-2. Total sample of respondents per province determined proportionally to the total population of the respected province. A total of **158** households was reached, with **111** households completing the interview. The difference (**47** households) has been reported as drop-offs. Some households did not respond due to a non-functioning biodigester. The distribution of respondent sample for each province, and each year of use, is described in Table 8.

**Table 8: BUS 2021 random sample size selection and geographical distribution (Age groups 1 through 5 are applicable to this MR)**[[19]](#footnote-19)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **PROVINCES** | **STATUS** | **Y 1** | **Y 2** | **Y3** | **Y4** | **Y5** | **TOTAL** |
| **Bali** | **Total approached** | 1 | 5 | 3 | 1 | 1 | 11 |
| Total completed | 1 | 3 | 3 | 0 | 0 | 7 |
| **West Java** | **Total approached** | 0 | 4 | 1 | 3 | 1 | 9 |
| Total completed | 0 | 3 | 0 | 2 | 1 | 6 |
| **Central Java** | **Total approached** | 2 | 0 | 0 | 2 | 5 | 9 |
| Total completed | 2 | 0 | 0 | 2 | 3 | 7 |
| **East Java** | **Total approached** | 10 | 13 | 5 | 4 | 5 | 37 |
| Total completed | 10 | 13 | 4 | 3 | 5 | 35 |
| **Lampung** | **Total approached** | 2 | 4 | 1 | 0 | 1 | 8 |
| Total completed | 2 | 4 | 1 | 0 | 0 | 7 |
| **NTB** | **Total approached** | 17 | 1 | 7 | 1 | 12 | 38 |
| Total completed | 16 | 0 | 5 | 1 | 5 | 27 |
| **NTT** | **Total approached** | 0 | 0 | 3 | 6 | 4 | 13 |
| Total completed | 0 | 0 | 1 | 1 | 2 | 4 |
| **South Sulawesi** | **Total approached** | 0 | 0 | 1 | 10 | 0 | 11 |
| Total completed | 0 | 0 | 0 | 7 | 0 | 7 |
| **Yogyakarta** | **Total approached** | 2 | 4 | 10 | 4 | 2 | 22 |
| Total completed | 2 | 0 | 4 | 3 | 2 | 11 |
| Total | | | |  |  |  |  |
| **9 provinces** | **Total sampled** | 34 | 31 | 32 | 31 | 30 | 158 |
| **Total approached** | 34 | 31 | 31 | 31 | 31 | 158 |
| **Total completed** | 33 | 23 | 18 | 19 | 18 | 111 |

The described BUS sampling plan is developed using guidance of the applied GS methodology and the UNFCCC standard on sampling (‘Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities’ (EB 69, Annex 4))[[20]](#footnote-20), see the next table:

**Table 9: BUS survey design**

|  |  |  |
| --- | --- | --- |
| **#** | **Item** | **Description** |
| 1 | Objectives and Reliability Requirements | The objective is to obtain unbiased and reliable estimates of the monitoring parameters at a confidence / precision level of at least 90/10. The actual design of the survey was done to ensure a confidence / precision level of 95/5, exceeding this requirement. |
| 2 | Target population | Households that have installed an IDBP certified biodigester. |
| 3 | Sampling method and sampling frame | Simple random sampling within similar cluster (on the age of usage), with Probability-Proportional-to-size (PPS) of users when determining distribution number of respondents for each province (multi-stage sampling, within similar cluster). |
| 3.1 | Number of clusters | Number of cluster was determined based on the objective of the study; i.e.: to understand the impact of the biogas plants installed among different age of usage – based on the Gold Standard’s definition. |
| 4 | Sampling frame | The sampling frame is a random selection of households that belong to the target population in the selected cluster. |

1. **Survey implementation**

**Surveyors**

Cooperation with PT. RASA, an Indonesian surveyor company that has an established working relationship with YRE, was established to execute the survey. PT. RASA recruited 13 surveyors and 2 supervisors for the enumeration. All these surveyors received training on survey and data collection techniques and they were supervised by the Project Leader during survey implementation. Office training was conducted on December 17th 2021; meanwhile field training was conducted on December 18th. Data tabulation, analysis and reporting was prepared by PT. RASA.

**Data collection tools**

The questionnaire was developed jointly by the carbon consultant and PT. RASA, in consultation with YRE. The questionnaire was pilot tested during the field visit organised as part of the surveyor training. Feedback from the field was used to finalise the questionnaire. Subsequently the questionnaire has been translated into Bahasa (Indonesian).

**Quality control**

Questionnaires for this survey were drafted by PT. RASA with reference to the objectives of the study and in consultation with YRE. Pre-testing of the questionnaire was conducted by the PT. RASA team. Based on the results of this field test, the questionnaire was finalised and sent to YRE for approval.

The fieldwork process was carried out by PT. RASA staff through house-to-house personal interviews using the structured questionnaire. To ensure good data quality, oversight of the fieldwork process was conducted by field supervisors, through the following ways:

* Team members internally discussed the findings with the senior staff to ensure reliability;
* Solving any new problem that might arise in the field;

Quality control process was also conducted by PT. RASA, through the following ways:

* Conduct control toward the filled questionnaires, for checking reliability of data on the questionnaires as well as their completeness;
* Follow up with phone calls to the interviewed household to verify that the surveys took place.[[21]](#footnote-21)

1. **Baseline Fuel Test (BFT) and the Project Performance Field Test (PFT)**

The baseline performance field tests (BFT) and project performance field test (PFT) measure real, observed technology performance in the field. Consumption is measured with a representative sample of end users under each defined baseline scenario (in the absence of the project technology) and project scenario. **The last KPT was conducted in December 2021 and January 2022. For the purpose of VPA-2, these BFT and PFT therefore apply.**

The KPT 20121-22 was executed according to this protocol:

* Test period shall be 1 days[[22]](#footnote-22) = the measurement campaign (MC).
* The selected test day will span fuel measurement consumption for human food cooking and boiling water totaling 24 hours.
* Cooking practices shall be during ‘normal days’. Normal days are defined as periods without extra eaters. Depending on the family, this excludes days like festivals or holidays or weekend days. The MC can take place in the weekend if it can be proven that fuel use is not higher during these days (i.e. the same number of people eat meals as during the week).
* Households are instructed that they cook normally during the test. The aim is to capture their usual behavior in the kitchen, as if no tests were happening, to feed the usual variation of people with the usual variation of food types.
* To conduct the tests, ensured is that the cook uses fuel only from a designated stock which is pre-weighed.
* During the tests, surveyor is to find out how many people have eaten and how many meals each, with the data to be entered into the data sheet as the number of “person-meals” (individual meals as opposed to meals shared) cooked with the weighed fuel each day. Note that this count can include meals sold commercially as well as meals consumed in the domestic environment. The number of people eating meals shall be recorded using the following categories: Child 0-14 years, Female over 14 years, male 15-59 and male over 59 years old.
* It is important that the fuel is typical of the fuel normally used through the year, particularly in terms of moisture content. It is also important that the subjects are paying for fuel, or have an incentive to conserve it, otherwise they may use excessive amounts due to the free hand-out. Subjects can be told they will be rewarded for their effort and time at the end of the test, once it is successfully completed.

1. **KPT survey design**

The KPT for VPA-2 targets two groups. Oversampling was conducted to minimise the necessity to redo the KPT in cases of wrongly filled out questionnaires or unreliable results:

**Table 10: KPT 2021 target groups**

|  |  |  |
| --- | --- | --- |
| **Group** | **Description of target group** | **Sample size** |
| PFT household | Randomly selected household from the project database with a biodigester | 93 |
| BFT household | Nearest equivalent households[[23]](#footnote-23) to the randomly selected project household without a biodigester | 39 |
|  | **Total sample** | **132** |

Only after data collection it can be known if the data meets the required precision, this is per Annex 4 of the applied methodology.

**Table 11: KPT survey design**

|  |  |
| --- | --- |
| **Item** | **Conversion in KPT** |
| **Sampling objective:** | The objective of the sampling effort is to obtain reliable fuel use data of project and equivalent baseline households |
| **Field Measurement** **Objectives and Data to be collected**: | The survey will consist of a 24-hour measurement campaign amongst PFT and BFT households |
| **Target Population and Sampling Frame:** | The sampling frame will be drawn from the project database |
| **Sampling method (approach):** | Simple random sampling, each observation is chosen randomly and entirely by chance, such that each observation has the same probability of being chosen. The BFT household is a neighboring equivalent household to the selected PFT |
| **Implementation:** | The KPT was executed between in December 2021 and January 2022. |
| **Desired Precision/Expected Variance and Sample Size.** | 90/30 rule of the applied methodology |
| **Procedures for Administering Data Collection and Minimizing Non-Sampling Errors:** | The survey data was entered by PT. RASA’s data processing staff and served as an independent check on the data collected by the IDBP |

**Representativeness of the KPT**

The KPT is executed for one day instead of the recommend 3-day minimum testing period by the Gold Standard. The GS confirmed that a one-day testing period is possible as long as it is representative. The next table shows how representativeness is safeguarded.

**Table 12: KPT representativeness issues and conversion**

|  |  |  |
| --- | --- | --- |
| **#** | **Issue** | **Conversion** |
| 1 | Questionnaire design | The questionnaire includes a question on if this is a normal day without extra eaters. If there are extra eaters, an appointment would be made with the household for a day with normal cooking conditions. To maintain conservativeness, weekends have also been regarded as non-normal days and have been excluded in the assessment. |
| 2 | Seasonality | The KPT was implemented in December 2019 and January 2020, which is during the dry season.[[24]](#footnote-24) As during the dry season less wood is needed for cooking purposes as the wood fuel, the primary fuel for cooking purposes of most households, contains less moisture. Seasonality does not impact usage rate of other fuels such as LPG and kerosene. Measurements conducted during the dry season can therefore be assumed to be conservative. |
| 3 | Applicability | The KPT is basically a test designed for improved cook stoves. As these stoves typically only reduce 20% of fuel a longer test period is necessary. Biogas project on the other hand replace typically 90 to 100% of the baseline fuel and it is therefore much easier to measure savings in a shorter period. |
| 4 | Representativeness | The KPT was implemented in a way to ensure that the households selected in the baseline KPT are representative of the households participating in the VPA. The surveyors ensured that the baseline KPT respondents have similar socio-economic conditions in terms of a similar household size, housing type, number and type of animals. Also, the sample was spread out geographically across a number of provinces to support representativeness. |
| 5 | Biodigester size distribution | Random sampling can result in a different size distribution than in the project database. Therefore, the sampling is done a couple of times to ensure a good match with the size distribution of the project database. However, since the KPT results apply to both VPA-1 and VPA-2, an ideal match across all biodigester sizes in both VPAs could not be achieved. For this reason, in the smallest size category the number of samples is lower than the share in the database.   |  |  |  |  | | --- | --- | --- | --- | | **Size (m3)** | **n**[[25]](#footnote-25) | **% in Sample** | **% in Project database** | | 4 | 32 | 34% | 58% | | 6 | 30 | 32% | 16% | | 8 | 18 | 19% | 5% | | 10 | 3 | 3% | 2% | | 12 | 6 | 6% | 3% | |

1. **KPT implementation**

**KPT Implementation**

KPT survey was performed with the same team who carried out the BUS. The surveying team is composed of 13 surveyors and 2 field supervisors.

**Questionnaire development and training**

The survey supervisor and the lead consultant developed a questionnaire based on the Berkeley Air Kitchen Performance test questionnaire. This document is also referenced in the applied TPDDTEC methodology. The KPT survey used a similar questionnaire structure as past years and therefore did not require any additional piloting test.

All selected surveyors received a 1-day office training by IDBP and 1-day field training by PT. RASA supervisor. Office training was conducted 2 days prior the field survey; meanwhile field training was conducted a day prior to the field survey. The lead trainer were Chabi Romzini from IDBP and Pak Andri Sugiono from PT RASA.

**Data Collection Tools**

As discussed above, the questionnaire was based on Berkeley Air KPT questionnaire.[[26]](#footnote-26) Calibration was done with the comparison of traditional weighing scale on 29/07/2019. The scales were also compared to each other and all weighing scales were found accurate. The calibration procedure was as follows:

1. Calibrated and certified weight stones were manufactured by Wei Hang, Portable Electronic Scale company;
2. The newton scales were checked with the weight stones to ensure that the scales were reliable before the start of the survey;
3. The scales were also compared to each other and all weighing scales were found accurate.
4. The survey team was instructed to check each morning if the scale was still providing reliable and unbiased weights using the calibrated weight.

**KPT execution**

The KPT was executed in the period from the 29th December 2021-25th January 2022. A day prior to the KPT, target respondents were visited to answer a set of screening questions[[27]](#footnote-27), and asking their willingness to participate to the survey. In total, 93 households participated in the PFT testing. Another 27 samples of non-biogas households residing close to the biogas household participants were also chosen for becoming comparison sample used for the baseline KPT. Care was taken that these households were similar in nature (household size, number of cattle, similar socio-economic conditions) as their neighbours with the biodigester. Note that a smaller number of households for the BFT applied as the BFT results are only applicable to VPA-2, while the PFT to both VPA-1 and VPA-2.

The KPT was executed across 9 provinces: Bali, West Java, East Java, Central Java, Lampung, West Nusa Tenggara, East Nusa Tenggara, South Sulawesi and Yogyakarta. All surveyed data were checked and processed by PT. RASA, and then reported to head office in Jakarta (NBPSO).

**KPT data tabulation**

To translate the collected primary data into results that feed into the monitoring data as per the PDD requirements, the following steps were followed. First, the primary data was screened for consistency and reliability by the surveyor supervisor. Oversampling was conducted to minimise the necessity to redo the KPT in cases of wrongly filled out questionnaires or unreliable results. Outliers were excluded using the Grubb’s test. A significance of 0.01, two-sided has been applied.[[28]](#footnote-28) All data has been deemed consistent and passes the Grubb’s test assessment.

Table 13 describes the approach applied in converting the obtained results to monitoring parameters as per PDD requirements.

**Table 13: Converting KPT results into monitoring parameters**

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Description** | **Approach** |
| **BBb,bio** | Amount of woody biomass used in the baseline scenario b | The amount of biomass consumed in the baseline and project scenarios was weighted and average usage for one day was established. This amount was multiplied by 365 to generate the tonnes/year. |
| **BBp,bio** | Quantity of biomass consumed in project scenario p during year y |
| **BBb,fuel** | Amount of fossil fuels used in the baseline scenario b | The amount of LPG and kerosene consumed in the baseline and project scenarios was measured in time and average usage for one day was established. This amount was multiplied by 365 to generate the tonnes/year. |
| **BBp,fuel** | Quantity of fossil fuel consumed in project scenario p |

During the KPT, LPG and kerosene was measured by calibrated weights.

1. DATA AND PARAMETERS
   1. Data and parameters fixed ex ante or at renewal of crediting period

>>

|  |  |
| --- | --- |
| **Data/parameter:** | **fNRB,y** |
| Unit | % |
| Description | Fraction of biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using nationally approved methods |
| Source of data | Reports, surveys, and government data |
| Value(s) applied) | 64.8 |
| Choice of data  or measurement methods and procedures | Calculated as per guidance of the applied methodology: |
| Purpose of data | For the calculation of the fraction of non-renewable biomass |
| Additional comments | Since the MR of VPA2 still covers the first crediting period of VPA-2, the PP refers to the fNRB of 64.8% as per the approved PDD. |

|  |  |
| --- | --- |
| **Data / Parameter** | **NRB** |
| **Unit** | m3 |
| Description | Non-renewable woody biomass |
| Source of data | FAO (2010) Global Forest Resources Assessment 2010 Country Report Indonesia; calculation |
| Value(s) applied | 55,984,649 |
| Choice of data or Measurement methods and procedures | NRB can be calculated by subtracting the DRB of 30,411,351 m3 from By of 86,396,000 m3. By is the amount of firewood removed from forests which amounts to 86,396,000 m3 (FAO, 2010). |
| Purpose of data | For the calculation of the fraction of non-renewable biomass |
| Additional comment | - |

|  |  |
| --- | --- |
| **Data / Parameter** | **DRB** |
| Unit | m3 |
| Description | Demonstrably renewable woody biomass |
| Source of data | FAO (2010) Global Forest Resources Assessment 2010 Country Report Indonesia; calculation |
| Value(s) applied | 30,411,351 |
| Choice of data or Measurement methods and procedures | The annual sustainable yield from the plantations is determined to be 35,490,000 m3, in line with 35,378,000 m3 estimated by ITTO (2009). The more conservative number 35,490,000 m3 is multiplied by the fraction of wood fuel removals from total wood removals (85.57%) reported by FAO, yielding yields the demonstrably renewable biomass (DRB) of 30,411,351 m3. |
| Purpose of data | For the calculation of the fraction of non-renewable biomass |
| Additional comment | - |

|  |  |
| --- | --- |
| Data / Parameter | **EFb1, bio** |
| Unit | tCO2/TJ |
| Description | Emission factor of the woody biomass used in the baseline scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied | 112 |
| Choice of data or Measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comment | IPCC (2006); May be updated according to any future changes by the IPCC. CO2 and non-CO2 emissions factors for charcoal may be estimated from project specific monitoring or alternatively by researching a conservative wood to charcoal production ratio (from IPCC, credible published literature, project-relevant measurement reports, or project-specific monitoring) and multiplying this value by the pertinent EF for wood |

|  |  |
| --- | --- |
| **Data/parameter:** | **EFp1, bio** |
| Unit | tCO2/TJ |
| Description | Emission factor of the woody biomass used in the project scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | 112 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC. |

|  |  |
| --- | --- |
| **Data/parameter:** | NCVbio |
| Unit | TJ/tonne |
| Description | Net calorific value of the non-renewable biomass used in the baseline scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | 0.015 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/parameter:** | **EFb1, fuel** |
| Unit | tCO2/TJ |
| Description | Emission factor of fossil fuels used in the baseline scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | Kerosene = 71.9  LPG = 63.1 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/parameter:** | **EFp1, fuel** |
| Unit | tCO2/TJ |
| Description | Emission factor of fossil fuels used in the project scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | Kerosene = 71.9  LPG = 63.1 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/parameter:** | **NCVfuel** |
| Unit | TJ/tonne |
| Description | Net calorific value of fossil fuels used in the baseline scenario |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied) | Kerosene = 0.0438  LPG = 0.0473 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines.  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/parameter:** | **ηbiogas stove** |
| Unit | % |
| Description | Combustion efficiency of the biogas stove introduced by the VPA |
| Source of data | LIPI Stove Report, 2010; Indonesian Government standard on stove efficiency |
| Value(s) applied) | 50 |
| Choice of data  or measurement methods and procedures | A comprehensive combustion efficiency test of the biogas stove introduced by the VPA was conducted in 2010 by LIPI, a governmental testing institute. The resulting efficiency of the biogas stoves was 52%. The Indonesian Government standard on stove efficiency indicates an efficiency of 50% is prevalent. The latter has been used to be conservative. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **EFawms,T** |
| Unit | kg CH4 |
| Description | Emission factor for the defined livestock population category T by average temperature (27.1°C) |
| Source of data | 2006 IPCC Guidelines for National Greenhouse Gas Inventories; Indonesian Meteorological Climatological and Geophysical Agency |
| Value(s) applied) | Dairy cows = 31  Other cattle = 1  Buffalo = 2  Market swine = 7  Goats = 0.22  Sheep = 0.20  Poultry = 0.02 |
| Choice of data  or measurement methods and procedures | As per requirement of the methodology and sourced from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines  The IPCC is a standard, credible source of emissions factors. |
| Purpose of data | For the calculation of emission reductions derived from fuel usage |
| Additional comments | IPCC (2006); May be updated according to any future changes by the IPCC. |

* 1. Data and parameters monitored[[29]](#footnote-29)

>>

|  |  |
| --- | --- |
| **Data/parameter:** | **Up1,y** |
| Unit | Fraction |
| Description | Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction) |
| Measured/calculated/default | Measured |
| Source of data | Collected through the annual Biogas User Survey; Biogas User Survey 2022 results have been used for the purpose of the ex-ante calculation – 20220420 BUS\_Tabulation 2021\_v.01.xlsx | Sheet Drop-off | Cell E22 - E26 |
| Value(s) of monitored parameter | 0.9172  With the following usage rate for each age group:   |  |  | | --- | --- | | **Age group** | **Usage rate** | | Age group 5 | 0.8387 | | Age group 4 | 0.9032 | | Age group 3 | 0.8387 | | Age group 2 | 0.9677 | | Age group 1 | 1 | |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): |  |
| QA/QC procedures: | The usage rate of thermal applications is monitored annually using survey methods to satisfy a 90/10 precision/confidence, following the ‘Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities’ (EB 69, Annex 4). |
| Purpose of data: | To account for the impact of dropped off units in the emission reduction calculation |
| Additional comments: | A single usage parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario. |

|  |  |
| --- | --- |
| **Data/parameter:** | **Np1,y** |
| Unit | Number |
| Description | Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y |
| Measured/calculated/default | Measured |
| Source of data | IDBP database. See 20220217 ER Calculation VPA2 MP5 CP1\_v02.xls sheet GS VER 2021, cell E86 |
| Value(s) of monitored parameter | Reported as a result of (Nop1,y \* **Up1,y** \*(Op1,y / 365)), which equals (6,266\* 0.9172\*362.36/365) = 5,706 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Continuous |
| Calculation method (if applicable): |  |
| QA/QC procedures: | The supplier shall provide hard copies of the ‘Household Agreement and the Completion Report to the CME, who will be responsible for entering data for the number of units installed each month into the centralised record-keeping database. It will be the CME’s responsibility to ensure that data is entered correctly and to follow-up with the supplier if there are errors or missing data. The database will not allow double-entries of the serial numbers. All original hard copies are filed and stored. |
| Purpose of data: | To account for non-operational units in the emission reduction calculation |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **Nop1,y** |
| Unit | Number |
| Description | Cumulative number of project technologies included in the project  database for project scenario p in year y |
| Measured/calculated/default | Measured |
| Source of data | 20220201\_IDBP\_Database\_VPA2.xlsx |
| Value(s) of monitored parameter | 6,266 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Continuous |
| Calculation method (if applicable): |  |
| QA/QC procedures: | The supplier shall provide hard copies of the ‘Household Agreement and the Completion Report to the CME, who will be responsible for entering data for the number of units installed each month into the centralised record-keeping database. This will enable the calculation of the cumulative number of units in the VPA. |
| Purpose of data: | To account for the cumulative number of units in the emission reduction calculation |
| Additional comments: | The actual cumulative number of biodigester operational days will be confirmed upon verification. |

|  |  |
| --- | --- |
| **Data/parameter:** | **Op1,y** |
| Unit | Number |
| Description | The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y |
| Measured/calculated/default | Measured |
| Source of data | See 20220217 ER Calculation VPA2 MP5 CP1\_v02.xls sheet GS VER 2021, cell E85 |
| Value(s) of monitored parameter | 362.36 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Continuous |
| Calculation method (if applicable): | The actual cumulative number of biodigester non-operational days will be confirmed upon verification. The equation to calculate this is (Op,y = 365 – non-operational days). Non-operational days are based on the number of observations of technical drop-offs, which need to be repaired within a 15 day period. For number of incidences reported during this MP, see: “20220201\_IDBP\_Database\_VPA2” | sheet “PLANTMAINT” | cell L42301 |
| QA/QC procedures: | As per procedures of the IDBP database |
| Purpose of data: | Emission reduction calculation |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **LEp1,y** |
| Unit | tCO2e/year |
| Description | Leakage in project scenario p during year y |
| Measured/calculated/default | Measured |
| Source of data | Collected through the annual Biogas User Survey. 20220217 ER Calculation VPA2 MP5 CP1\_v02.xls sheet GS VER 2021, cell E77 |
| Value(s) of monitored parameter | 0.073 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Every two years |
| Calculation method (if applicable): |  |
| QA/QC procedures: | The leakage will be monitored once every two years using survey methods to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | To account for leakage |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **NT,h** |
| Unit | Number |
| Description | Number of animals of livestock category T in premise h |
| Measured/calculated/default | Measured |
| Source of data | BUS 2021 – “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | sheet “Tabulation”| cell AA119 |
| Value(s) of monitored parameter | Cow = 6.07 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | Analysis of animal ownership from the BUS 2021 shows that dairy cows are the dominant type of animal owned by almost all biodigesters users (82%). Given the marginal emission impact of the latter two categories and for conservativeness, only methane emissions from dairy cows will be considered in this emissions reduction calculation. Methane emissions from secondary and any following animal types are not included for conservativeness. This means that the total average number of animals kept amounted to 6.07 cows per household. |
| QA/QC procedures: | Ex-post value to be derived from the Biogas User Survey |
| Purpose of data: | To calculate the baseline and project emissions associated with animal waste handling |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **PL** |
| Unit | % |
| Description | Physical leakage of the biodigester |
| Measured/calculated/default | Default |
| Source of data | IPCC |
| Value(s) of monitored parameter | Estimated using a 10% default rate of total methane production |
| Monitoring equipment | N/A |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): |  |
| QA/QC procedures: |  |
| Purpose of data: | To calculate the physical leakage associated with the use of the technology |
| Additional comments: | As per Annex 6 of the applied methodology |

|  |  |
| --- | --- |
| **Data/parameter:** | **BBb1,bio** |
| Unit | Tonnes/year |
| Description | Amount of woody biomass used in the baseline scenario 1: households |
| Measured/calculated/default | Measured |
| Source of data | KPT Survey, December 2021- January 2022 – “Biogas KPT & Non 2021.xls” | sheet 90-30 test | cell F50 |
| Value(s) of monitored parameter | 0.549 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Updated every two years through the Baseline Performance Field Test |
| Calculation method (if applicable): |  |
| QA/QC procedures: | Ex-post value to be determined through the Baseline Performance Field Test |
| Purpose of data: | To calculate the baseline emissions associated with fuel use |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **BBb1,fuel** |
| Unit | Tonnes/year |
| Description | Amount of fossil fuels used in the baseline scenario 1: households |
| Measured/calculated/default | Measured |
| Source of data | KPT Survey, December 2021- January 2022 – “Biogas KPT & Non 2021.xls” | sheet 90-30 test | cells L50 and I50 |
| Value(s) of monitored parameter | LPG = 0.168  Kerosene = 0.007 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Updated every two years through the Baseline Performance Field Test |
| Calculation method (if applicable): |  |
| QA/QC procedures: | The following conversion factor for kerosene is applied: 1 liter = 0.82 kg[[30]](#footnote-30)  Ex-post value to be determined through the Baseline Performance Field Test. |
| Purpose of data: | To calculate the baseline emissions associated with fuel use |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **BBp1,fuel** |
| Unit | Tonnes |
| Description | Quantity of fossil fuel consumed in project scenario 1 during year y, in tonnes |
| Measured/calculated/default | Measured |
| Source of data | KPT Survey, December 2021- January 2022 – “Biogas KPT & Non 2021.xls” | sheet 90-30 test | cells AC103 and Z103 |
| Value(s) of monitored parameter | LPG: 0.1  Kerosene: 0.000 |
| Monitoring equipment | Weight scale |
| Measuring/reading/recording frequency: | Updated every two years through the Project Performance Field Test |
| Calculation method (if applicable): | Project KPT was executed in December 2021- January 2022 targeting 93 households. A weight scale manufactured by Wei Hang, Portable Electronic Scale company, was applied. |
| QA/QC procedures: | Shall be in line with Section 7 of the applied methodology. |
| Purpose of data: | To calculate the project emissions associated with fuel use |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **BBp1,bio** |
| Unit | Tonnes |
| Description | Quantity of biomass consumed in project scenario p during year y, in tonnes |
| Measured/calculated/default | Measured |
| Source of data | KPT Survey, December 2021- January 2022 – “Biogas KPT & Non 2021.xls” | sheet 90-30 test | cell W103 |
| Value(s) of monitored parameter | 0.300 |
| Monitoring equipment | Weight scale |
| Measuring/reading/recording frequency: | Updated every two years through the Project Performance Field Test |
| Calculation method (if applicable): | Project KPT was executed in December 2021- January 2022 targeting 93 households. A weight scale manufactured by Wei Hang, Portable Electronic Scale company, was applied. |
| QA/QC procedures: | Shall be in line with Section 7 of the applied methodology. |
| Purpose of data: | To calculate the project emissions associated with fuel use |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **MSP,S,K** |
| Unit | % |
| Description | Fraction of livestock category T’s manure not treated in bio-digester, in climate region k |
| Measured/calculated/default | Measured |
| Source of data | “20220420 BUS\_Tabulation 2021\_v.01.xlsx s” | sheet “Tabulation”| cell V274 |
| Value(s) of monitored parameter | 17.2 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | Survey |
| QA/QC procedures: | - |
| Purpose of data: | To calculate the project emissions associated with bio-slurry |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **MST,S,k** |
| Unit | % |
| Description | Fraction of livestock category T's manure fed into the bio-digester, S in climate region k |
| Measured/calculated/default | Measured |
| Source of data | “20220420 BUS\_Tabulation 2021\_v.01.xlsx s” | sheet “Tabulation”| cell V273 |
| Value(s) of monitored parameter | 82.8 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | Survey |
| QA/QC procedures: |  |
| Purpose of data: | To calculate the project emissions associated with bio-slurry |
| Additional comments: | Applicable to VPAs applying Tier 2 only |

|  |  |
| --- | --- |
| **Data/parameter:** | **GWPCH4** |
| Unit | - |
| Description | Global Warming Potential of methane |
| Measured/calculated/default | Default |
| Source of data | IPCC AR5 (2014) |
| Value(s) of monitored parameter | 28 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | IPCC default |
| QA/QC procedures: |  |
| Purpose of data: | To calculate the baseline and project emissions associated with animal waste handling |
| Additional comments: | May be updated according to any future changes by the IPCC |

|  |  |
| --- | --- |
| **Data/parameter:** | **Bio** |
| Unit | % |
| Description | Use of bio-slurry |
| Measured/calculated/default | Measured |
| Source of data | “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | sheet “Tabulation”| cell T326 |
| Value(s) of monitored parameter | 68.5 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | To be updated through the annual Biogas User Survey |
| QA/QC procedures: | The application of bio-slurry shall be monitored according the applied methodology, and in line with the approach used in project GS 1083. If there is any anaerobic use/storage of bio-slurry under anaerobic conditions reported from the monitoring survey, project emissions shall be accounted for accordingly. |
| Purpose of data: | To be used for the calculation of project emissions associated with bio-slurry usage – the CH4 emissions from the anaerobic decay of the residual organic content of digestate subjected to anaerobic storage. |
| Additional comments: |  |

The report will also consider the following SDG impact parameters:[[31]](#footnote-31)

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-03 Soil condition** |
| Unit | Number |
| Description | Soil condition refers to changes compared to the baseline in organic matter content. |
| Measured/calculated/default | Measured |
| Source of data | Collected through the annual Biogas User Survey. “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | sheet “Tabulation”| cell T326 |
| Value(s) of monitored parameter | 68.5%, equivalent to 4,290 households (68.5% \* 6,266 biodigesters) |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | Number of users applying the final biodigester slurry on agricultural land. Data is to be collected annually. |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-06 Quality of employment** |
| Unit | Number |
| Description | Quality of employment refers to changes compared to the baseline in the qualitative value of employment, such as whether the jobs resulting from the project activity are highly or poorly qualified, temporary or permanent. The proportion of employees attending vocational training programs as well as Health and Safety courses, as proven through issuance of a certificate to all constructors, will be monitored. |
| Measured/calculated/default | Measured |
| Source of data | IDBP Database. “20220201\_IDBP\_Database\_VPA2.xls” | sheet “SPV” | cell M225 |
| Value(s) of monitored parameter | 12 vocational trainings conducted during this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021) |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | All vocational training and Health and Safety training attendees will be issued with a certificate proving their attendance, and a record of their names, contact details and gender, will be kept as part of the CME’s consolidated monitoring database. Data is to be collected annually. |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). Hard copies of all certificates issued will be kept by the CME. |
| Purpose of data: | SDG impact monitoring |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-07 Livelihood of the poor** |
| Unit | % |
| Description | Livelihood of the poor refers to changes compared to the baseline in living conditions, access to healthcare services including affordability and poverty alleviation. |
| Measured/calculated/default | Measured |
| Source of data | Collected through the annual Biogas User Survey. “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | sheet “Tabulation”| cell K332 – K334 |
| Value(s) of monitored parameter | ‘Worsened’: 79 (equivalent to 1.3% of total units in operation)  ‘The same’: 2,459 (equivalent to 39.2% of total units in operation)  ‘Improved’: 3,728 (equivalent to 59.5% of total units in operation) |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | Carried out as part of the annual Biogas User Survey conducted by the IDBP. As part of this survey the following question will be included: “Do you feel that your living conditions have a) improved, b) stayed the same, c) worsened; since the installation of the biogas digester?” |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-08 Access to affordable and clean energy services** |
| Unit | Number |
| Description | Access to energy services refer to changes in unsustainable energy use. This will be monitored through the nteh will be monitored throughumber of biogas units commissioned. |
| Measured/calculated/default |  |
| Source of data | Collected through the IDBP Database. “20220201\_IDBP\_Database\_VPA2.xls” | sheet “Master VPA-2” |cell H6758 |
| Value(s) of monitored parameter | 6,266 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | As in the assessment of parameter ‘N’ above, the unique serial number of each installation will be recorded upon commissioning and entered into the electronic database, with clear divisions between VPAs. This will allow a count of the number of systems commissioned. |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: |  |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-09 Human and institutional capacity** |
| Unit | Number |
| Description | Changes compared to the baseline in education and skills, gender equality and empowerment. Women spend much of their time collecting firewood and cooking, and have little spare time to undertake activities that stimulate personal and entrepreneurial development. The number of women attending the Operation and Maintenance training as well as the bio-slurry utilization training will be monitored. |
| Measured/calculated/default | Measured |
| Source of data | IDBP Database; “20220201\_IDBP\_Database\_VPA2.xls” | sheet “O&M training”| cell H5266 |
| Value(s) of monitored parameter | 304 Women attending Operation and Maintenance training in this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021)  1,381 Women attending Operation and Maintenance training in the period 2017-2021 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annual |
| Calculation method (if applicable): | As per the VPA-DD, the number of women attending the Operation and Maintenance training as well as the bio-slurry utilization training are monitored to indicate changes in gender equality. This data concerns cumulative results over the VPAs lifetime |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-10 Quantitative employment and income generation** |
| Unit | Number |
| Description | The number of jobs generated by within the IDBP as well as the number of constructors employed will be monitored. To evidence income generation, the number of users selling biodigester slurry on the market will be monitored. |
| Measured/calculated/default | Annual |
| Source of data | Employment records and through the IDBP Database; Biogas User Survey.  “20220201\_IDBP\_Database\_VPA2.xls”| sheet “SPV”| cell “M224”  “20220201\_IDBP\_Database\_VPA2.xls”| sheet “SPV”| cell “M229” |
| Value(s) of monitored parameter | 162 number of direct jobs created by the VPA during the monitoring period 01/01/2021 – 31/12/2021  63 number of constructors employed under the VPA during the monitoring period 01/01/2021 – 31/12/2021  As per the VPA-DD, the number of jobs generated by the VPA as well as the number of constructors employed is monitored. To evidence income generation, the number of users selling biodigester slurry on the market is also monitored. |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annually |
| Calculation method (if applicable): | Through the Biogas User Survey, the number of users selling biodigester slurry on the market will be monitored. |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data/parameter:** | **GS-12 Technology transfer and technological self-reliance** |
| Unit | Number |
| Description | Refers to changes compared to the baseline in activities that build usable and sustainable know-how in a region/country for a technology, where know-how was previously lacking. The number of constructors trained and users attending the operation and maintenance training will be monitored. Also, the entities outside of the programme in general and technical training about the functioning of the biodigester technology to promote knowledge dissemination and strengthen the domestic biogas market will be monitored. |
| Measured/calculated/default | NA |
| Source of data | Training records and through the IDBP Database; Biogas User Survey. ” 20220201\_IDBP\_Database\_VPA2 xls” | sheet “O&M training” | cells H5266 and H5272 |
| Value(s) of monitored parameter | 867 users trained during this monitoring period (i.e., MP5, from 01/01/2021 to 31/21/2021)  5,255 users trained in the period 2017-2021 |
| Monitoring equipment | NA |
| Measuring/reading/recording frequency: | Annually |
| Calculation method (if applicable): | Records will be kept of all staff and their attendance at the vocational training programmes. All attendees will be issued with a certificate proving attendance and skills gained. Monitoring of this parameter will be combined with the monitoring of GS- 10. A record of all training held, and attendees, will be kept in the programme database. |
| QA/QC procedures: | This will be monitored through sampling to satisfy the requirements put forth by the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). |
| Purpose of data: | SDG impact monitoring |
| Additional comments: | - |

|  |  |
| --- | --- |
| **Data / Parameter** | **GS-13 Establishment of sustainable food production area** |
| Unit | Hectare |
| Description | Area with application of bio-slurry or compost. |
| Source of data | See: “20220420 GS-13 calculation 2021.xls” | sheet ‘Analysis’ | cell C29 |
| Value(s) applied | 122.20 |
| Measurement methods and procedures | Area of agricultural land with application of final biodigester slurry. Data is to be collected annually. |
| Monitoring frequency | Annually. |
| QA/QC procedures | This will be monitored through sampling to satisfy the requirements put forth by the methodology Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011). |
| Purpose of data | SDG impact monitoring. |
| Additional comment |  |

|  |  |
| --- | --- |
| **Data / Parameter** | **GS-14 Time saved** |
| Unit | % |
| Description | The share of women indicating to save time by not having to collect biomass for cooking purposes after the installation of the biodigester. |
| Source of data | Collected through the annual Biogas User Survey. See: 20220420 BUS\_Tabulation 2021\_v.01.xlsx | sheet ‘Tabulation | cells K339 and M339 |
| Value(s) applied | 93.5 (equivalent to 5,862 women) |
| Measurement methods and procedures | The BUS will ask respondents whether after the installation of a biodigester women (1) collect firewood (2) does not collect firewood |
| Monitoring frequency | Annually |
| QA/QC procedures | This will be monitored through sampling to satisfy the requirements put forth by the methodology Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011). |
| Purpose of data | SDG impact monitoring. |
| Additional comment |  |

|  |  |
| --- | --- |
| **Data / Parameter** | **GS-15 Productive use of time** |
| Unit | % |
| Description | Share of women indicating to use the additional saved time that has been freed up by not having to collect biomass for cooking purposes for income generating activities. |
| Source of data | Collected through the annual Biogas User Survey. 20220420 BUS\_Tabulation 2021\_v.01.xlsx | sheet ‘Tabulation | cells K345 and M345 |
| Value(s) applied | 32.3 (equivalent to 2,023 women) |
| Measurement methods and procedures | The BUS will ask respondents how they use the saved time, with income generation activities as one of the possible responses. |
| Monitoring frequency | Annually. |
| QA/QC procedures | This will be monitored through sampling to satisfy the requirements put forth by the methodology Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011). |
| Purpose of data | SDG impact monitoring. |
| Additional comment |  |

* 1. Comparison of monitored parameters with last monitoring period

|  |  |  |
| --- | --- | --- |
| Data/Parameter | Value obtained in this monitoring period | Value obtained in last monitoring period |
| **SDG 13 Climate action** | **14,804** | 10,975 tCO2e |
| **GS-03 Soil condition** | 4,290 households | 1,946 households |
| **GS-06 Quality of employment** | 12 vocational trainings conducted during this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021)  75 people attending vocational training during VPA implementation | 5 vocational trainings conducted during this monitoring period (i.e., MP4, between 01/01/2020 and 31/12/2020)  63 people attending vocational training during VPA implementation |
| **GS-07 Livelihood of the poor** | ‘Worsened’: 79 (equivalent to 1.3% of total units in operation)  ‘The same’: 2,459 (equivalent to 39.2% of total units in operation)  ‘Improved’: 3,728 (equivalent to 59.5% of total units in operation | ‘Worsened’: 113 (equivalent to 2.4% of total units in operation)  ‘The same’: 1,318 (equivalent to 28.4% of total units in operation)  ‘Improved’: 3,205 (equivalent to 69.1% of total units in operation) |
| **GS-08 Access to affordable and clean energy services** | 1,582 units installed in this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021)  6,266 units in operation | 4,636 units in operation |
| **GS-09 Human and institutional capacity** | 304 Women attending Operation and Maintenance training in this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021).  1,381 Women attending Operation and Maintenance training in the period 2017-2021 | 126 Women attending Operation and Maintenance training in this monitoring period (i.e., MP4, between 01/01/2020 and 31/12/2020).  1,077Women attending Operation and Maintenance training in the period 2017-2020 |
| **GS-10 Quantitative employment and income generation** | 63 number of constructors employed under the VPA  162 number of direct jobs created by the VPA  0 households selling bio-slurry during the monitoring period | 81 number of constructors employed under the VPA  144 number of direct jobs created by the VPA  32.19 households sell the bio-slurry on the market (0.7% of total) |
| **GS-12 Technology transfer and technological self-reliance** | 867 users trained during this monitoring period (i.e., MP5, from 01/01/2021 to 31/21/2021)  5,255 users attending training between 2017-2021. | 325 users trained during this monitoring period (i.e., MP4, from 01/01/2020 to 31/21/2020)  4,408 users attending training between 2017-2020. |
| **GS-13 Establishment of sustainable food production area** | 122.20 hectares | 15.45 hectares |
| **GS-14 Time saved** | 93.5% (equivalent to 5,862 women) | 60.5% (equivalent to 2,803 women) |
| **GS-15 Productive use of time** | 32.3% (equivalent to 2,023 women | 26.6% (equivalent to 1,234 women) |

* 1. Implementation of sampling plan

>>

Sampling Design

*Objectives and reliability requirements*

The objective of the sampling effort is to meet the monitoring requirements set forth in the methodology ‘Technologies and Practices to Displace Decentralized Thermal Energy Consumption’ (11/04/2011). In accordance with the requirements set forth in the methodology, the sample size will be selected following at least a 90% confidence interval and a 10% margin of error (90/10), where applicable.

Multi-stage sampling[[32]](#footnote-32) will be applied, where clusters consisted of geographical areas and subunits. It is considered more cost-effective to treat several respondents within a local area as a cluster. In order to account that not all the geographical clusters are the same size, sampling will be employed proportionate to cluster size. Clusters will be selected with a probability proportionate to the size of the target population within each cluster such that larger clusters have a greater probability of selection, and smaller clusters a lower probability. This helps to ensure that sampling remains representative of the entire population. Sampling shall be done per user group (i.e. households, SMEs, communities) and shall differentiate between small-scale digesters (defined as capacity up to 12m3) and medium-scale digesters (defined as capacities larger than 12m3).

As the PoA progresses and the number of VPAs increases, this VPA may also fall under a single monitoring plan that can be applied as outlined in Section of E.7.2 of the PoA-DD, covering several VPAs, adopting a confidence/precision level of 95/10 according paragraph 20 of the "Standard for Sampling and Surveys for CDM Project Activities and Programme of Activities” (EB 69, Annex 4). This option can be applied to a group of similar VPAs.

*Target population and sampling frame*

The monitoring survey is only conducted with end users representative of the project scenario using the biodigester at the time of the survey. There are three distinct target populations for the application of monitoring procedure (households, local communities, and SMEs with installed biodigesters), as identified through the centralised record-keeping database managed by the CME. All units covered under the programme are benefitting from a IDBP subsidy and maintenance support and sign carbon ownership rights with the programme. They therefore cannot be included in another programme. The database therefore does not allow for double-entries.

*Sampling method and sample size*

The CME is responsible for the production of periodical monitoring reports for the VPA-2, following the criteria outlined in below. The minimum total sample size is 100, with at least 30 samples for project technologies of each age being credited[[33]](#footnote-33). Sampling shall be performed separately per target population (households, communities, SMEs). A usage parameter must be established to account for the drop off rates as project technologies age and are replaced. This parameter shall be representative of the quantity of project technologies of each age being credited in the project scenario.

*Implementation*

All sampling efforts will be conducted by qualified personnel who have undergone training as part of the VPA. This training will cover information on the project background and basic functioning of the biogas systems, as well as the data collection process, including the format in which data should be collected. The personnel will be issued with a certificate confirming their attendance at relevant trainings and their qualification to complete the monitoring. A paper copy of the certificate will also be kept by the CME. Surveyor staff will be required to speak the native language (Bahasa Indonesia) in which biogas systems have been implemented, allowing for full understanding of any responses given by users, and any questions therein.

*Baseline scenario data collection*

Baseline data for the VPA-2 has been established *ex-ante* for households through Baseline KPT implemented in December 2015. A day prior to the KPT, target respondents were visited to answer a set of screening questions[[34]](#footnote-34), and asking their willingness to participate to the survey. In total, 51 samples of non-biogas households residing close to the biogas households participants were also chosen for becoming comparison sample used for the baseline KPT. Care was taken that these households were similar in nature (household size, number of cattle, similar socio-economic conditions) as their neighbours with the biodigester. The Baseline KPT was executed across 4 provinces: West Java, Central Java, East Java, and NTB (West Nusa Tenggara). All surveyed data were checked and processed by PT. RASA, and then reported to head office in Jakarta (NBPSO).

Baseline emissions relating to use of biomass and fossil fuel are confirmed *ex-post* through the Baseline Performance Field test (BFT) of fuel consumption, as described in Section 7 of the methodology.

*Project scenario data collection*

Project emissions relating to continued use of biomass and fossil fuel are confirmed *ex-post* through the Project Performance Field tests (PFTs) of fuel consumption, as described in Section 7 of the methodology.

All personnel conducting the Project Performance Field tests and annual monitoring of the VPA-2, will receive training on the procedures to be used for data collection, including the format in which data should be collected, project background, basic functioning of the biogas systems, training given to users on the application of slurry to soil and record-keeping system for the quantity of manure fed into the system and any other relevant project background. Response rates will be maximised by contacting all randomly-selected biogas system users beforehand to arrange a practical site visit date and sampling over the minimum required number to compensate for any non-responses. The programme database will have a provision for recording any monitoring carried out in reference to the serial number of the installed system. In cases where participants refuse to participate in the monitoring, the reason shall be documented in the CME’s programme database. The CME will explain that monitoring is part of the requirements of the general programme and try to arrange an alternative date for a site visit, or carryout monitoring with another member of the households.

Quality control procedures include training of all surveyors to ensure streamlined data collection procedures, a system for filing all completed paper surveys by the VPA and serial number, and for ensuring that all monitored data is complete. The name, date and contact details of the surveyor will be detailed on all completed monitoring surveys, therefore allowing for the follow-up of all incomplete data.

*Field measurement objectives and data to be collected*

The parameters to be monitored within VPA-2, as outlined in the applied methodology, are as follows:

A Biogas User Survey shall be completed annually and covers the following data:

* Number of users applying the final biodigester slurry on agricultural fields– annually;
* Perceived improvement of living conditions – annually;
* Number of women attending trainings – annually;
* Percentage of biodigester in use in the given year (y) – annually.
* The number of operational days of the biodigesters in the given year (y) – annually.
* The fraction of manure that is not treated in the biodigester – annually.

A Monitoring Survey shall be completed periodically and covers the following data:

* Quantity of biomass and fossil fuel that is used for cooking in a given baseline scenario in a given year (y) – once every two years;
* Quantity of biomass and fossil fuel that is used for cooking in a given project scenario in a given year (y) – once every two years;
* Leakage in the given project scenario in the given year (y) – once every two years.

The application of bio-slurry shall be monitored according the applied methodology. If there is any anaerobic use/storage of bio-slurry under anaerobic conditions reported from the monitoring survey, project emissions shall be accounted for accordingly. The following approach shall be followed:

* Estimation of the total amount of VS entering the biodigester;
* Assessment of remaining VS content of digestate;
* Assessment of methane potential of bio-slurry;
* MCF of the digestate management systems;
* Calculation of project emissions using the information obtained in the previous steps.

1. CALCULATION OF SDG IMPACTS
   1. Calculation of baseline value or estimation of baseline situation of each SDG Impact

>>

|  |  |  |
| --- | --- | --- |
| **SDG indicator** | **GS indicator** | **Baseline situation** |
| **SDG13: Climate action**  The estimated annual emission reduction is based on methodology “Technologies and practices to displace decentralized thermal energy consumption”.  The cumulative ex-ante emission reductions are calculated with the following calculation:  ER y = BE y - PE y – LE y  Whereby:  **BE y: BEb1,CO2,y + CH4,y**  PE y: PEp1 CO2,y + CH4,y  LE y: LEp1 CO2,y + CH4,y | Climate change | Baseline emissions from fuel consumption:    Baseline emissions from the animal waste management system:    Together amounting to:  **34,057 tCO2e**  *\* Please refer to cell G96 of “20220217 ER Calculation VPA2 MP5 CP1\_v02.xls”* |
| **SDG 7: Affordable and Clean Energy** | GS-08 Access to affordable and clean energy services | No access to biodigester technology. Combustion of LPG, kerosene and biomass continues to lead to particulate matter and carbon monoxide pollution and deforestation. |
|  | GS-12 Technology transfer and technological self-reliance | No training opportunities and transfer of technology in the biogas sector. |
| **SDG 5: Gender Equality** | GS-09 Human and institutional capacity | No development as women spend much of their time collecting biomass and cooking, and remain with little spare time to undertake activities that stimulate personal and entrepreneurial development. |
|  | GS-14 Time saved | No time savings, as women spend a significant proportion of their time having to collect biomass for cooking purposes. |
|  | GS-15 Productive use of time | No productive use of time as women lack spare time to pursue income generating activities. |
| **SDG 2: No Hunger** | GS-03 Soil condition | No slurry is used as fertilizer on agricultural land (in terms of number of farmers). |
|  | GS-13 Establishment of sustainable food production area | No slurry is used as fertilizer on agricultural land (in terms of area). |
| **SDG 1: No Poverty** | GS-06 Quality of employment | No training and employment opportunities linked to biogas market. |
|  | GS-07 Livelihood of the poor | Livelihood of the poor is unchanged. |
|  | GS-10 Quantitative employment and income generation | No training and employment opportunities linked to biogas market. |

* 1. Calculation of project value or estimation of project situation of each SDG Impact

>>

|  |  |  |
| --- | --- | --- |
| **SDG indicator** | **GS indicator** | **Project situation** |
| SDG13: Climate action  The estimated annual emission reduction is based on methodology “Technologies and practices to displace decentralized thermal energy consumption”.  The cumulative ex-ante emission reductions are calculated with the following calculation:  ER y = BE y - PE y – LE y  Whereby:  BE y: BEb1,CO2,y + CH2,y  **PE y: PEp1 CO2,y + CH4,**y  LE y: LEp1 CO2,y + CH4,y | Climate change | Project emissions from fuel consumption:    Project emissions from the animal waste management system:    Together amounting to:  **18,863 tCO2e**  *\* Please refer to cell G97 of “20220217 ER Calculation VPA2 MP5 CP1\_v02.xls”* |
| **SDG 7: Affordable and Clean Energy** | GS-08 Access to affordable and clean energy services | **6,266** biodigester technologies installed, calculated by tracking in the IDBP database all eligible biodigesters installed until 31/12/2021. |
|  | GS-12 Technology transfer and technological self-reliance | **867** users attending training in this monitoring period (i.e., MP5, between 01/01/2021and 31/12/2021), calculated by tracking in the IDBP database all user trainings during 2021  **5,255** users attending training, calculated by tracking in the IDBP database all user trainings until 31/12/2021. |
| **SDG 5: Gender Equality** | GS-09 Human and institutional capacity | **304** women attending training in this monitoring period (i.e., MP5, between 01/01/2021 and 31/12/2021), calculated by tracking in the IDBP database all O&M trainings during 2021  **1,381** women attend the Operation and Maintenance training, calculated by tracking in the IDBP database all O&M trainings until 31/12/2021. |
|  | GS-14 Time saved | **93.5%** of women reporting to have saved time, as calculated by the BUS survey responses with 93.5% of the 6,266 biodigesters installed (0.935\* (6,266 = 5,862) during MP5 |
|  | GS-15 Productive use of time | **2,023** womenreporting to have more time for productive use, as calculated by the BUS survey responses with 32.3% 6,266 biodigesters installed (0.323\* 6,266 = 2,023) during MP5 |
| **SDG 2: No Hunger** | GS-03 Soil condition | **4,290** households use bio-slurry on land, as calculated by the BUS survey responses with 68.5% of the 6,266 biodigesters installed (0.685\*6,266=4,290) during MP5 |
|  | GS-13 Establishment of sustainable food production area | **122.20** hectares applying bio-slurry, per month, calculated by correcting the total units (6,266) by the drop-off rate (10.08%) and multiplying it by bio-slurry usage as fertilizer according to the BUS (67%) and finally applying conversions to get to hectares during MP5 |
| **SDG 1: No Poverty** | GS-06 Quality of employment | **12** vocational trainings conducted during this monitoring period, calculated by tracking in the IDBP database all vocational trainings during MP5  **75** vocational trainings conducted, calculated by tracking in the IDBP database all vocational trainings until 31/12/2021. |
|  | GS-07 Livelihood of the poor | ‘Worsened’: **79** (equivalent to 1.3% of total units in operation)  ‘The same’: **2,459** (equivalent to 39.2% of total units in operation)  ‘Improved’: **3,728** (equivalent to 59.5% of total units in operation during MP5 |
|  | GS-10 Quantitative employment and income generation | **63** number of constructors employed under the VPA during MP5, calculated by tracking in the IDBP database all constructor employment opportunities.  **162** number of direct jobs created by the VPA during MP5, calculated by tracking in the IDBP database all employment opportunities. |

* 1. Calculation of leakage

>>

|  |  |  |
| --- | --- | --- |
| **SDG indicator** | **GS indicator** | **Project situation** |
| SDG13: Climate action  The estimated annual emission reduction is based on methodology “Technologies and practices to displace decentralized thermal energy consumption”.  The cumulative ex-ante emission reductions are calculated with the following calculation:  ER y = BE y - PE y – LE y  Whereby:  BE y: BEb1,CO2,y + CH2,y  PE y: PEp1 CO2,y + CH4,y  **LE y: LEp1 CO2,y + CH4,y** | Climate change | **LE y: LEp1 CO2,y + CH4,y**  0.073 tCO2e per unit.  6,266 units \* 0.073\* usage rate = 390 tCO2e |

* 1. Calculation of net benefits or direct calculation for each SDG Impact

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **SDG** | **SDG Impact** | **Baseline estimate** | **Project estimate** | **Net benefit** |
| SDG13: Climate action  The estimated annual emission reduction is based on methodology “Technologies and practices to displace decentralized thermal energy consumption”.  The cumulative ex-ante emission reductions are calculated with the following calculation:  ER y = BE y - PE y – LE y  Whereby:  BE y: BEb1,CO2,y + CH2,y  PE y: PEp1 CO2,y + CH4,y  LE y: LEp1 CO2,y + CH4,y | Climate change | **34,057** tCO2e  Baseline emissions from fuel consumption:    Baseline emissions from the animal waste management system: | **18,863**tCO2e as per the equation:  Project emissions from fuel consumption:    Project emissions from the animal waste management system:    **Project emissions from leakage 390 tCO2e:**  **LE y: LEp1 CO2,y + CH4,y** | **14,804**tCO2e  The net benefit is calculated with the following calculation:  ER y = BE y - PE y – LE y  Outlined in Sections E.1 through to E.3 |
| SDG 7: Affordable and Clean Energy | GS-08 Access to affordable and clean energy services | No access to biodigester technology. Combustion of LPG, kerosene and biomass continues to lead to particulate matter and carbon monoxide pollution and deforestation. | **1,582** biodigester technologies installed during MP5  **6,266** biodigester technologies installed in the period 2017 - 2021. | **1,582** biodigester technologies installed during MP5  **6,266** biodigester technologies installed in the period 2017 - 2021. |
|  | GS-12 Technology transfer and technological self-reliance | No training opportunities and transfer of technology in the biogas sector. | **867** users trained during MP5  **5,255** users attending training in the period 2017-2021. | **867** users trained during MP5  **5,255** users attending training in the period 2017-2021. |
| SDG 5: Gender Equality | GS-09 Human and institutional capacity | No development as women spend much of their time collecting biomass and cooking, and remain with little spare time to undertake activities that stimulate personal and entrepreneurial development. | **304** Women attending Operation and Maintenance training during MP5  **1,381** women attend the Operation and Maintenance training in the period 2017-2021 | **304** Women attending Operation and Maintenance training during MP5  **1,381** women attend the Operation and Maintenance training in the period 2017-2021. |
|  | GS-14 Time saved | No time savings, as women spend a significant proportion of their time having to collect biomass for cooking purposes. | **5,862** women reporting to have saved time during MP5 | **5,862** women reporting to have saved time during MP5 |
|  | GS-15 Productive use of time | No productive use of time as women lack spare time to pursue income generating activities. | **2,023** women reporting to have more time for productive use during MP5 | **2,023** women reporting to have more time for productive use during MP5 |
| SDG 2: No Hunger | GS-03 Soil condition | No slurry is used as fertiliser on agricultural land (in terms of number of farmers). | **4,290** households use bio-slurry on land during MP5 | **4,290** households use bio-slurry on land during MP5 |
|  | GS-13 Establishment of sustainable food production area | No slurry is used as fertiliser on agricultural land (in terms of area). | **122.20** hectares applying bio-slurry, per month during MP5 | **122.20** hectares applying bio-slurry, per month during MP5 |
| SDG 1: No Poverty | GS-06 Quality of employment | No training and employment opportunities linked to biogas market. | **12** vocational trainings conducted during MP5  **75** vocational trainings conducted in the period 2017-2021. | **12** vocational trainings conducted during MP5  **75** vocational trainings conducted in the period 2017-2021. |
|  | GS-07 Livelihood of the poor | Livelihood of the poor is unchanged. | ‘Worsened’: 79 (equivalent to 1.3% of total units in operation)  ‘The same’: 2,459 (equivalent to 39.2% of total units in operation)  ‘Improved’: 3,728 (equivalent to 59.5% of total units in operation during MP5 | ‘Worsened’: 79 (equivalent to 1.3% of total units in operation)  ‘The same’: 2,459 (equivalent to 39.2% of total units in operation)  ‘Improved’: 3,728 (equivalent to 59.5% of total units in operation during MP5 |
|  | GS-10 Quantitative employment and income generation | No training and employment opportunities linked to biogas market. | **162** number of direct jobs created by the VPA during MP5  **63** number of constructors employed under the VPA during MP5 | **162** number of direct jobs created by the VPA during MP5  **63** number of constructors employed under the VPA during MP5 |

* 1. Comparison of actual SDG Impacts with estimates in approved PDD

|  |  |  |
| --- | --- | --- |
| **SDG** | **Values estimated in ex ante calculation of approved PDD**  **for this monitoring period** | **Actual values achieved during this monitoring period** |
| SDG 13: Climate action | ER y = BE y – PE y – LE y  Being:  53,162 – 25,255 – 596=  **27,311** tCO2e | ER y = BE y – PE y – LE y  Being:  34,057 – 18,863 – 390 =  **14,804** tCO2e during MP5 |
| SDG 7: Affordable and Clean Energy | No access to biodigester technology. Combustion of LPG, kerosene and biomass continues to lead to particulate matter and carbon monoxide pollution and deforestation (GS-08) | **1582** biodigester technologies installed during MP5  **6,266** biodigester technologies installed in the period 2017 – 2021. |
|  | No training opportunities and transfer of technology in the biogas sector (GS-08) | **867** users trained during MP5  **5,255** users attending training in the period 2017-2021. |
| SDG 5: Gender Equality | No development as women spend much of their time collecting biomass and cooking, and remain with little spare time to undertake activities that stimulate personal and entrepreneurial development (GS-09) | **304** Women attending Operation and Maintenance training during MP5  **1,381** women attend the Operation and Maintenance training in the period 2017-2021. |
|  | No time savings, as women spend a significant proportion of their time having to collect biomass for cooking purposes (GS-09) | **5,862** women reporting to have saved time during MP5 |
|  | No productive use of time as women lack spare time to pursue income generating activities (GS-09) | **2,023** women reporting to have more time for productive use during MP5 |
| SDG 2: No Hunger | No slurry is used as fertilizer on agricultural land (in terms of number of farmers) (GS-03) | **4,290** households use bio-slurry on land during MP5 |
|  | No slurry is used as fertilizer on agricultural land (in terms of area) (GS-03) | **122.20** hectares applying bio-slurry, per month during MP5 |
| SDG 1: No Poverty | No training and employment opportunities linked to biogas market (GS-06) | **12**  vocational trainings conducted during MP5  **75** vocational trainings conducted in the period 2017 - 2021 |
|  | Livelihood of the poor is unchanged (GS-07) | ‘Worsened’: **79** (equivalent to 1.3% of total units in operation)  ‘The same’: **2,459** (equivalent to 39.2% of total units in operation)  ‘Improved’: **3,728** (equivalent to 59.5% of total units in operation during MP5 |
|  | No training and employment opportunities linked to biogas market (GS-06) | **162** number of direct jobs created by the VPA during MP5, **63** number of constructors employed under the VPA during MP5 |

* + 1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

>>

The BE, PE and ER that were estimated in the PDD are shown in the next table:

**Table 14: BE, PE and ER as estimated in the PDD (per household, per year)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Scenario** | BE (tCO2e) | PE (tCO2e) | LE (tCO2e) | **ER** (tCO2e) |
| Biomass and fossil fuel substitution | 1.720 | 0.557 | 0.058 | **1.104** |
| Methane avoidance | 3.464 | 1.905 | - | **1.559** |
| **Total** | 5.36 | 2.40 | 0.074 | **2.663** |

The ex-ante estimated ER is in line with the ER estimated in this MR. The small observed differences are caused by:

* On the household level: The amounts of biomass reported in the baseline study (1.259 tonnes/year) is higher than the amounts measured in the KPT (0.549 tonnes/year); the KPT results however indicate a slightly higher usage of LPG (0.168 tonnes/year compared to 0.117 tonnes/year, ex-ante). These factors combined explain the decrease from the ex-ante ER estimate of 1.104 tCO2e to ex-post 0.423 tCO2e due to biomass and fossil fuel substitution.
* On the household level: The number of dairy cows reported in the baseline study (average of 4.47 per household) is lower than the number reported in the BUS 2021 (average of 6.07 per household). This factor explains the increase from the ex-ante ER of 1.559 tCO2e to ex-post 2.355 tCO2e due to methane avoidance.

The difference between the ex-ante (2.663 tCO2e) and ex-post (2.778 tCO2e) emission reductions on the household level and the update of GWP value of methane (CH4) from 25 to 28 in accordance with the rule update of Applicability Of Global Warming Potential For Gold Standard for the Global Goals Projects explain part of the variation of the total annual differences between the ex-ante and ex-post emission reductions.

* On the VPA level: total annual ex-post emission reductions (14,804 tCO2e) are below the ex-ante annual average emission reduction reported in the VPA-DD (27,311 tCO2e). While the decrease in ex-post emission reduction per unit is one explanation, the other reason for this difference is the lower implementation rate than the 20,000 units estimated ex-ante in the VPA-DD.

The small-scale thresholds of 45MWth (Type I) and 60,000 tCO2e (Type III) are not surpassed by the VPA. For evidence of fit within the Type I threshold, refer to Table 4 of this MR which shows that given 46,266 units implemented to date under the VPA-2, this VPAs capacity cumulates to 7.18 MWth. This is below the 45MWth.

For Type III, as each biodigester produces a maximum emission reduction of 2,355tCO2e, given 6,266 biodigesters installed, the cumulative amount of emission reductions from the methane avoidance component is 14,755 tCO2e. This is below the 60,000 tCO2e. Annualised, the results are as follows:

**Table 15: Overview of ex-ante and ex-post VPA results versus applicable small-scale thresholds**

|  |  |
| --- | --- |
| Type | 01/01/2021 to 31/12/2021 |
| **Ex-ante** |  |
| Type I (45 MWth) | 39.2 MWth[[35]](#footnote-35) |
| Type III (60,000 tCO2e) | 30,000 tCO2e[[36]](#footnote-36) |
| **Ex-post** |  |
| Type I (45 MWth) | 7.18 MWth[[37]](#footnote-37) |
| Type III (60,000 tCO2e) | 14,755 tCO2e[[38]](#footnote-38) |

* 1. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

>>

|  |  |  |  |
| --- | --- | --- | --- |
|  | Current MP | PDD estimate | Explanation |
| SDG 13 | Total emission reduction: **14,804** tCO2e/ this monitoring period. | Total emission reduction: **27,311** tCO2e/ average ex ante estimate in PDD. | The monitored value under this monitoring period is 46% lower than the estimated value. This is due to a lower implementation number, as the current VPA is not yet filled to its maximum allowed capacity. |
| SDG 7: Affordable and Clean Energy | **1,582** biodigester technologies installed during MP5.  **6.266** biodigester technologies installed in the period 2017 – 2021. | **20,000** biodigester technologies installed. | VPA-2 is still being implemented and has not yet reached its full capacity. |
|  | **867** users trained during MP5  **5,255** users attending training in the period 2017-2021. | - | As the PDDs were developed prior to the GS for Global Goals, no other ex-ante SDG impacts are reported in the approved PDDs. |
| SDG 5: Gender Equality | **304** Women attending Operation and Maintenance training during MP5  **1,381** women attend the Operation and Maintenance training in the period 2017-2021 | - | Same as above |
|  | **5,862** women reporting to have saved time during MP5 | - | Same as above |
|  | **2,023** women reporting to have more time for productive use during MP5 | - | Same as above |
| SDG 2: No Hunger | **4,290** households use bio-slurry on land during MP5 | - | Same as above |
|  | **122.20** hectares applying bio-slurry, per month during MP5 | - | Same as above |
| SDG 1: No Poverty | **12** vocational trainings conducted during MP5  **75** vocational trainings conducted in the period 2017 - 2021 | - | Same as above |
|  | ‘Worsened’: 79 (equivalent to 1.3% of total units in operation)  ‘The same’: 2,459 (equivalent to 39.2% of total units in operation)  ‘Improved’: 3,728 (equivalent to 59.5% of total units in operation during MP5 | - | Same as above |
|  | **162** number of direct jobs created by the VPA during MP5, 63 number of constructors employed under the VPA during MP5 | - | Same as above |

1. SAFEGUARDS REPORTING

>>

No additional safeguarding principles that were added to the monitoring plan.

1. STAKEHOLDER INPUTS AND LEGAL DISPUTES
   1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

|  |  |  |  |
| --- | --- | --- | --- |
| Period | Grievances ongoing | Grievances closed | Total |
| 01/01/2021 – 31/12/2021 | 34 | 20 | 54 |

All grievances are repair requests. 3 main problems are: broken outlet, leakage on dome and broken stove.

The grievance mechanism has three main components to receive, respond and address grievances: 1. IDBP Hotline, 2. Directly contact YRE Field officer, and 3. Directly contact the CPO

The above grievances received in the monitoring period were addressed through the following three channels.

IDBP Hotline: Below is a flow of how grievances are received and handled through this channel:

Diagram

Description automatically generated

Directly contact YRE Field officer. Below is a flow of how grievances are handled through this channel:

Diagram

Description automatically generated

Directly contact the CPO: Below is a flow of how grievances are handled through this channel:

Diagram

Description automatically generated

* 1. Report on any stakeholder mitigations that were agreed to be monitored.

There are 34 grievances from stakeholders to be mitigated for this monitoring period. Six of these grievances have been addressed by CPOs. The repairs have been completed in 2022. There are 28 units of biodigester still in the process of being repaired by the CPO. YRE field officer has made Term of Reference for repair activity as work order for the CPO to do the reparations.

* 1. Provide details of any legal contest that has arisen with the project during the monitoring period

There are no legal contests or disputes that have arisen in the project during this MP.

APPENDIX. DETAILED EMISSION REDUCTION CALCULATION

### Emission reduction component 1: Accounting for emission reductions due to the displacement of fossil fuels and non-renewable biomass

Emission reductions are credited by comparing fuel consumption in a project scenario to the baseline scenario of VPA-2. As the baseline fuel and the project fuel and the corresponding emission factors are different, the overall GHG reductions achieved by VPA-2 in year *y* are calculated as follows:

**(1)**

Where:

ERCO2,y Cumulative CO2 emission reductions from the substitution of non-renewable biomass and fossil fuels

∑b1,p1 Sum over all relevant (baseline b1/project p1) couples

Np1,y Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

Up1,y  Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

ERb1,p1,y,CO2Specific CO2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, in tCO2/year, and as derived from the statistical analysis of the data collected from the field tests

ERb1,p1,y,non-CO2Specific non-CO2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, converted in tCO2/year, and as derived from the statistical analysis of the data collected from the field tests

*f*NRB Fraction of biomass used that can be established as non-renewable biomass

LEp1,y Leakage for project scenario p1 in year y (tCO2e/yr)

As there is one common baseline scenario and one type of technology applied, and specific non-CO2 emission savings are treated in a separate equation (equation **7** onwards), the VPA-2 can apply the following formula for calculating emission reductions:

**(2)**

Where:

∑ERCO2,y Cumulative CO2 emission reductions from the substitution of non-renewable biomass and fossil fuels

∑BEb1,CO2,y Cumulative baseline emissions as calculated below under formula (**3**) of the VPA PDD

∑PEp1,CO2,y Cumulative project emissions as calculated below under formula (**4**) of VPA PDD

∑LEp1,CO2,y Cumulative leakage as per methodology guidance[[39]](#footnote-39)

Np1,y Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

Up1,y  Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

**Baseline emissions**

Baseline emissions are calculated as follows:

**(3)**

Where:

BEb1,CO2,y Cumulative baseline CO2 emissions from the use non-renewable biomass and fossil fuels at households during year y

BBb1,fuel The quantity of fossil fuel consumed in the baseline scenario 1, in tonnes/year

NCVfuel Net calorific value of fossil fuel, in TJ/tonne

EFb1,fuel CO2 emission factor of fossil fuel in baseline scenario 1, in tonnes/TJ

BBb1,bio The quantity of biomass consumed in the baseline scenario 1, in tonnes/year

NCVbio Net calorific value of biomass, in TJ/tonne

EFb1,bio CO2 emission factor of biomass in baseline scenario 1, in tonnes/TJ

*f*NRB Fraction of non-renewable biomass, in percentage

The inputs for the fuel usage data were collected by the KPT survey.

The next table shows the outcome of the BFT, fuel used and the amount of energy.

**Table 16: Thermal energy demand based on KPT results**[[40]](#footnote-40)

|  |  |  |  |
| --- | --- | --- | --- |
| Fuel | Average per household (tonne/year) | NCV (TJ/tonne) | Thermal energy demand  (TJ/year) |
| Biomass | 0.549 | 0.015 | 0.008235 |
| LPG | 0.168 | 0.0473 | 0.0079464 |
| Kerosene | 0.007 | 0.0438 | 0.0003066 |

In absence of national relevant emission factors, the default emission factors from the IPCC 2006 Guidelines for National Greenhouse Gas Inventories, volume 2: Energy, Chapter 1 are used, see the next table.

**Table 17: CO2 emission factors**

|  |  |
| --- | --- |
| Fuel *i* | EF­CO2, (tonne/TJ) |
| Biomass | 112.00 |
| LPG | 63.1 |
| Kerosene | 71.9 |

The fNRB is estimated to be 64.8%, as per the respective registered VPA-DD. The fNRB value is applicable to CO2 emissions from biomass and charcoal consumption and production. Methane and nitrous oxide emission are not included in the emission reduction calculation for conservativeness. The calculated ex-post baseline emissions are shown in next table:

**Table 18: Ex-post baseline emission of each fuel and total from thermal energy use[[41]](#footnote-41)**

|  |  |
| --- | --- |
| Fuel | Baseline emissions from CO2 (tCO2e/yr) |
| Biomass | 0.598 |
| LPG | 0.501 |
| Kerosene | 0.022 |
| **Total** | **1.121** |

**Project emissions**

The project scenario is defined by the fuel consumption of end users within the targeted population that adopts the biodigester technology. This formula calculates the project emissions per household:

**(4)**

Where:

PEp1,CO2,y Cumulative project CO2 emissions from the use non-renewable biomass and fossil fuels at households during year y

BBp1,fuel The quantity of fossil fuel consumed in the project scenario 1, in tonnes/year

NCVfuel Net calorific value of fossil fuel, in TJ/tonne

EFp1,fuel CO2 emission factor of fossil fuel in project scenario 1, in tonnes/TJ

BBp1,bio The quantity of biomass consumed in the project scenario 1, in tonnes/year

NCVbio Net calorific value of biomass, in TJ/tonne

EFp1,bio CO2 emission factor of biomass in project scenario 1in tonnes/TJ

*f*NRB Fraction of non-renewable biomass, in percentage

Not all fuels will be replaced by biogas. The fuels that people continue to use in the project scenario is sourced from the KPT-PFT.

**Table 19: KPT PFT fuel use**[[42]](#footnote-42)

|  |  |  |  |
| --- | --- | --- | --- |
| Fuel | Average per household  (tonne/year) | NCV  (TJ/tonne) | Thermal energy demand  (TJ/year) |
| Biomass | 0.300 | 0.015 | 0.0045 |
| LPG | 0.100 | 0.0473 | 0.00473 |
| Kerosene | 0.00 | 0.0438 | 0.00 |

The calculated emissions from fuel use in the project scenario are depicted in the following table:

**Table 20: KPT PFT emissions[[43]](#footnote-43)**

|  |  |
| --- | --- |
| Fuel | Project emissions from CO2 (tCO2e/yr) |
| Biomass | 0.327 |
| LPG | 0.298 |
| Kerosene | 0.00 |
| **Total** | **0.625** |

**Leakage emissions**

Leakage per household per year shall be calculated as a quantitative emissions volume (tCO2e) or as a percentage of total emission reductions. The former approach is followed in this MR.

A leakage assessment has been conducted as part of the BUS 2021, and is valid for a period of two years as per Gold Standard guidance. According to the results reported by households that are neighbors to biogas users, 11/129 of the households uses more fuel (biomass, LPG, and/or kerosene) because of the neighbor having a biogas digester. This amounts to leakage emissions of 0.073 tCO2e per year.[[44]](#footnote-44)

**Emission reductions**

Total emission reductions due to the displacement of non-renewable biomass and fossil fuels per VPA per year will be calculated as:

**(5)**

Where:

ERCO2,y Emission reductions in year y (tCO2)

BEb1,CO2,y Baseline emissions during the year y (tCO2)

PEp1,CO2,y Project emissions during the year y (tCO2)

LEp1,CO2,y Leakage during the year y (tCO2)

In other words, emission reductions from fuel savings are the difference between the BFT and the PFT and corrected for any leakage emissions, provided that the mean emission reductions are satisfy the 90/30 rule[[45]](#footnote-45), i.e. the endpoints of the 90% confidence interval lie within +/-30% of the estimated mean.

**90/30 rule check**

The check is calculated using the approved method that was communicated with the Gold Standards and is based on:

* GHG emission from all fuels of BFT and PFT
* fNRB of 64.8%

The calculations itself are based on the reference in the TPPDEC methodology[[46]](#footnote-46) and based on two independent samples. Paired sampling in the case of a market-oriented biogas programme is not possible as it is not known who will adopt the technology beforehand. The next tables show that both baseline emissions and project emissions calculations meet the 90/30 rule.

**Table 21: 90/30 rule check on baseline emissions**[[47]](#footnote-47)

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Unit | Baseline |  |
| **Sample** | n | 39 |  |
|  | **Analysis** | | |
|  | Mean | | 1.16 |
|  | Standard error | | 1.1668 |
|  | Minimum requirement n | | 30.50 |
|  | Satisfy the 90/30 rule | | Yes, as:  39 > 30.50 |

**Table 22: 90/30 rule check on project emissions**[[48]](#footnote-48)

|  |  |  |  |
| --- | --- | --- | --- |
| Item | Unit |  | Project |
| **Sample** | n |  | 93 |
|  | **Analysis** | | |
|  | Mean | | 0.85 |
|  | Standard error | | 1.0348 |
|  | Minimum requirement n | | 44.21 |
|  | Satisfy the 90/30 rule | | Yes, as:  93 > 44.21 |

The KPT test meets the 90/30 rule allowing the use of mean saving values for ER calculations. The following table summarises the total emission reduction from fuel-switch, per average biodigester:

**Table 23: Emission reductions from fuel switch[[49]](#footnote-49)**

|  |  |  |  |
| --- | --- | --- | --- |
| Baseline emissions from fuel use    (tCO2e/yr) | Project emissions from fuel use  (tCO2e/yr) | Leakage emissions from fuel use  (tCO2e/yr) | Emissions from fuel switch to biogas  (tCO2e/yr) |
| 1.121 | 0.625 | 0.073 | **0.423** |

### Emission reduction component 2: Accounting for emission reductions due to the avoidance of methane emissions from manure handling.

The emissions from the animal waste management system of the baseline are determined using the IPCC 2006 Tier 1 approach. The Tier 1 approach is applicable to situations where baseline data required for the estimation of the methane emission factor per category of livestock in *not* available, or where it is difficult to define a distinct practice of manure handling within the programme boundary.

**Baseline emissions**

This formula calculates the baseline emissions per household:

**(6)**

Where:

BEb1,CH4,y Baseline emissions from manure handling during the year y in tCO2e

GWPCH4 Global Warming Potential of methane (28)

EFawms, T Emission factor for the defined livestock population category T

NT,h Number of livestock category T in premise h

**Step 1: Determination of EFawms, T**

The relevant default methane emission factor (EFawms, T) for Asian livestock is sourced from Tables 10.14 – 10.16 of the IPCC Guidelines for National Greenhouse Gas Inventories[[50]](#footnote-50). These values are reported in Table 24. A national average temperature of 27.1°C applies, as reported by the Indonesian Meteorological Climatological and Geophysical Agency.[[51]](#footnote-51)

**Table 24: IPCC 2006 default values for EFawms, T[[52]](#footnote-52)**

|  |  |
| --- | --- |
| Animal T | EFawms, T |
| Dairy cow | 0.031 tonne CH4 |

**Step 2: Determination of NT,h**

Analysis of animal ownership from the BUS (2021) shows that cows are the dominant type of animal owned by almost all biodigesters users (83%). Given the marginal emission impact of the other categories of animals and for conservativeness, only methane emissions from dairy cows will be considered in this emissions reduction calculation. Methane emissions from secondary and any following animal types are not included for conservativeness.

With the data from the previous tables the baseline emission can be determined. The emission per household of all dairy cows under the VPA are calculated and depicted in the next table. The number of dairy cows originates from the BUS survey and based on the EFawms,T from the relevant default methane emission factor.

**Table 25: Ex-post Baseline emission from animal waste management[[53]](#footnote-53)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Animal T | Average population  NT,h/hh[[54]](#footnote-54) | EFawms, T (tonneCH4/year) | GWPCH4 | BEb1,CH4,y (tCO2e/year) |
| Cow | 6.07 | 0.031 | 28 | **5.269** |

**Project emissions**

Project emissions include both the physical leakage of biogas from the biodigester and the incomplete combustion of biogas. This formula calculates the project emissions per household:

(**7**)

Where:

PEp1,CH4,y Project emissions from manure handling during the year y in tCO2e

GWPCH4 Global Warming Potential of methane (28)

NT,h Number of livestock category T in premise h

EFawms, T Emission factor for the defined livestock population category T

PLy Physical leakage of the biodigester (through measurement or application of 10% default)

η new stove Combustion efficiency of the used type of biogas stove

PEawms,NT Project emission from the animal waste not treated in the biodigester

Project emissions from the animal waste not treated in the biodigester in the project scenario will be zero since the non-treated animals in the project scenario will have the same situation as they would have had in the baseline.

**Table 26: Ex-post Project emission from animal waste management[[55]](#footnote-55),[[56]](#footnote-56)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Animal T | BEb1,CH4,y (tCO2e/year) | PLy | ηnew stove | PEp1,CH4,y (tCO2e/year) |
| Cow | 5.269 | 10% | 50% | **2.898** |

The emission reductions from animal waste are the difference between the baseline and the project, as per the table below. Please note that here project emissions from bio-slurry are not included – refer to the section below for an overview of the calculation of project emissions from bio-slurry and Section D.4 (c) for how these project emissions have been accounted for in the final calculation.

### Leakage emissions

The project proponent investigated the following potential sources of leakage:

**Table 27: Leakage emission assessment**

|  |  |  |
| --- | --- | --- |
| **#** | **Leakage source** | **Applicability** |
| **a** | The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project. | The baseline technologies are not reused outside the project boundary. Traditional biomass stoves cannot be moved as they are fixed to the floor of the kitchenette. LPG stoves are retained by households and are needed for days with larger cookeries, such as festivals or national celebrations. |
| **b** | The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources. | It is considered as project emissions – see Section D.4 (a) Leakage. A leakage assessment has been conducted as part of the BUS 2021, and is valid for a period of two years as per Gold Standard guidance. According to the results reported by households that are neighbors to biogas users, 11/129 of the households uses more fuel (biomass, LPG, and/or kerosene) because of the neighbor having a biogas digester. This amounts to leakage emissions of 0.073 tCO2e per year.[[57]](#footnote-57) |
| **c** | The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario. | There is no registered project in Indonesia that has a NRB component in the project. It is therefore not likely that the NRB fraction is impacted significantly. |
| **d** | The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology | Space heating does not occur in Indonesia. |
| **e** | By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline. | The combustion of biogas is both more efficient than using open-source fires for cooking purposes and leads to lower emissions compared to the baseline fuels (biomass and LPG) as it is 100% renewable. |
| **F** | Physical leakage emissions | It is considered as project emissions - see section D.4 and the emission reduction calculation spread sheet |
| **G** | Emissions from biogas slurry | It is considered as project emissions - see section D.4 and the emission reduction calculation spread sheet. This amounts to leakage emissions of 0.073 tCO2e per year.[[58]](#footnote-58) |

### Emissions from bio-slurry (digestate)

The following leakage emission source is accounted for in this section: CH4 emissions from the anaerobic decay of the residual organic content of bio-slurry subjected to anaerobic storage. Bio-slurry typically has low biodegradability because easily biodegradable organic matter has been converted in the anaerobic digester and therefore the biodegradability of bio-slurry is much lower than manure. This approach has been approved by the GS for the project GS1083 and is therefore followed.

This emission source is determined through the following steps:

1. Estimation of the total amount of volatile solids (VS) entering the biodigester
2. Assessment of remaining VS content of bio-slurry
3. Assessment of methane potential of bio-slurry
4. Calculation of project emissions from bio-slurry using the information obtained in the previous steps
5. **Estimation of the total amount of VS entering the biodigester**

The total amount of VS entering the biogas plant depends on the type of animal and the share of manure that is fed into the biogas plant. The share of manure fed into the biogas plant can be found in section D.2, and is calculated as:

**MST,S,k** = 1 - **MSP,S,K**

Where, MST,S,k is the share of manure fed into the digester and MSP,S,K the share not fed into the digester of animal category T.

The next tables depict the total amount of VS that enters the average biodigester which is calculated by multiplying the amount of VS excreted by the average number of animals and the MST,S,k into the biodigester.

**Table 28: Daily VS production of the average biodigester[[59]](#footnote-59),[[60]](#footnote-60)**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Animal T | VS excretion  kgVS/hd/day | Head/average biodigester[[61]](#footnote-61) | Total amount of VS excreted  kgVS.day-1 | MST,S,k  Share fed into biodigester | Total VS entering the biodigester  kgVS.day-1 |
|  | **A** | **B** | **AxB =C** | **D** | **CxD** |
| Cow | 2.80 | 6.07 | 17.00 | 0.828 | 14.07 |
| **Sum** | | | | | 14.07 |

1. **Assessment of remaining VS content of bio-slurry**

During anaerobic digestion VS is converted into biogas. The efficiency of that process determines how much VS remains in bio-slurry. The efficiency depends on many factors and is difficult to estimate, such as retention time, dilution ratio, temperature C/N ratio etc.

According to the Biogas Handbook (2008) of Big East, the digestion efficiency of agricultural biogas plants is typically in the range 50-60%[[62]](#footnote-62). This means that bio-slurry contains 40-50% of the initial organic dry matter, primarily as fibers.

In other words, it can be assumed that around 55% of the initial concentration of VS is converted into biogas and that around 45% remains in bio-slurry. This means that the MST,S,k is 55% and the MSP,S,K is 45% of total VS entering the biogas plant.

The remaining VS however has a different composition than VS in manure, it is more fibrous and therefore it will more slowly degrade under continued anaerobic conditions. Some compounds, could even be recalcitrant to further anaerobic biodegradation. The next table shows the calculated amount of VS that leaves the average biodigester per day:

**Table 29: Average amount of VS in digester effluent[[63]](#footnote-63)**

|  |  |  |  |
| --- | --- | --- | --- |
| (A) Total VS entering the biodigester  kgVS.day-1 | Digester efficiency[[64]](#footnote-64) | (B) Total VS destroyed in the biodigester  kgVS.day-1 | A-B  Total VS in bio-slurry  kgVS.day-1 |
| 14.07 | 55% | 45% | 6.33 |

1. **Assessment of the methane potential of bio-slurry**

As the nature of VS has changed during anaerobic conversion, the default methane potential (Bo) value is no longer applicable to VS in bio-slurry. According to EB66 Annex 32[[65]](#footnote-65) the remaining fraction of the original methane potential is 20% for the liquid bio-slurry of conventional digesters. The effluent from biodigesters in Indonesia is liquid and therefore this fraction was applied. The B0 of bio-slurry is calculated with the following equation:

Bo,dig,T = Fww,CH4,default × B0,T

*Equation 1: Calculation of methane potential of bio-slurry*

Where:

|  |  |  |
| --- | --- | --- |
| Bo,dig,T | = | Methane potential of bio-slurry from animal type T manure |
| Fww,CH4, | = | Default factor representing the remaining CH4 production capacity of liquid bio-slurry |
| B0,T | = | Methane potential of manure from animal type T |

With this equation it is possible to calculate for each animal the remaining methane potential.

**Table 30: Calculated methane potential of digestate from manure by animal type[[66]](#footnote-66)**

|  |  |  |  |
| --- | --- | --- | --- |
| Animal T | Fww,CH4, | Bo(T)  (m3CH4/kgVS) | Bo,dig  (m3CH4/kgVS) |
| Dairy cow | 0.20 | 0.13 | 0.026 |

As discussed above, only dairy cows are taken into consideration for analysis, relevant calculation is shown in the table below:

**Table 31: Average methane potential of bio-slurry from manure by animal type[[67]](#footnote-67)**

|  |  |  |  |
| --- | --- | --- | --- |
| Animal T | Number | Fraction | Average Bo,dig  (m3CH4/kgVS) |
| Dairy cow | 6.07 | 100% | 0.026 |
|  |  |  | **0.026** |

Based on this, the weighted averaged B0,dig is 0.026 (m3CH4/kgVS)

1. **Calculation of bio-slurry emissions using the information obtained in the previous steps**

Fww and Bo, dig is a default factor and applicable to the remaining VS in the bio-slurry, see equation 6 of EB 66 Annex 32. However, as it is now known what the COD concentration of liquid bio-slurry is, the proxy VS remaining in bio-slurry is used. The next table shows the calculated emissions from bio-slurry using the IPCC tier 1 approach.

*Equation 2: Calculation of methane potential of bio-slurry*

PEbio-slurry = (VS dig \* 365) × B0,dig x (∑DMS x MCF) x (DCH4/1000) x GWP CH4

Where:

|  |  |  |
| --- | --- | --- |
| PEbio-slurry |  | Annual average project emissions from bio-slurry, tCO2e/hh/yr |
|  |  |  |
| VSdig | = | Daily volatile solid remaining in the bio-slurry, kgVS/day |
|  |  |  |
| 365 | = | Basis for calculating annual VS production, days yr-1 |
|  |  |  |
| B0,dig | = | Weighted methane producing capacity of the bio-slurry, m3CH4/kgVS |
|  |  |  |
| ∑MCF | = | Cumulative methane conversion factors for digestate management system DMS, % |
|  |  |  |
| DCH4 | = | Conversion factor of m3 CH4 to kilograms CH4 |
|  |  |  |
| GWP CH4 | = | Global Warming Potential of methane (28) |

The MCF applied to the bio-slurry emissions is 1.44%. The table below indicates the usage method of the bio-slurry and the corresponding calculation of the MCF.

**Table 32: Overview of bio-slurry handling methods[[68]](#footnote-68)**

|  |  |  |  |
| --- | --- | --- | --- |
| Bio-slurry handling method | Percentage | Corresponding IPCC definition | MCF |
| Use as fertilizer | 68.5% | Daily spread | 0.685% |
| Given away for free to neighbor | 5.4% | Daily spread | 0.054% |
| Left where it is | 1% | Liquid/slurry | 0.703% |
| Dumped into river or lake | 25.2% | Aerobic treatment | 0.00% |
| Sold | 0% | Daily spread | 0.0% |
| **Average MCF** | | | **1.44%** |

**Table 33: Calculated emissions from bio-slurry, per household**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Total VS in bio-slurry  kgVS.day-1 | B0,dig  (m3CH4/kgVS) | ∑DMSxMCF | DCH4  (kg/m3CH4) | PEbio-slurry (tCO2/year/hh) |
| 6.33 | 0.026 | 1.44% | 0.67 | 0.016 |

The project emissions from bio-slurry equate to 0.014 tCO2e. These have been included in the ER assessment.

**Emission reductions**

Total emission reductions due to avoided methane from animal waste management per VPA per year will be calculated as follows:

**(7)**

Where:

ERCH4,y Methane emissions reductions in year y (tCO2)

BEb1,CH4,y Baseline methane emissions during the year y (tCO2)

PEp1,CH4,y Project methane emissions during the year y (tCO2)

PEbio-slurry Project emissions from bio-slurry during the year y (tCO2)

LEp1,CH4,y Leakage during the year y (tCO2)

**Table 34: Emission reductions from animal waste management[[69]](#footnote-69)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Baseline emissions from animal waste management    (tCO2e/yr) | Project emissions from animal waste management  (tCO2e/yr) | Project emissions bio-slurry  (tCO2e/yr) | Leakage emissions from animal waste management  (tCO2e/yr) | Emissions from animal waste management  (tCO2e/yr) |
| 4.704 | 2.587 | 0.014 | - | **2.102** |

### Ex-post estimate of the emission reductions

The next table shows the ex-ante estimate of the emission reductions for each biogas unit:[[70]](#footnote-70)

**Table 35: Average annual emission reductions**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | BEb1,y (tCO2e/year) | PEp1y (tCO2e/year) | PE bio-slurry (tCO2e/year) | LEb1y (tCO2e/year) | ER,y (tCO2e/year) |
| Biomass and fossil fuel substitution | 1.21 | 0.936 | - | 0.073 | **0.423** |
| Manure handling | 5.269 | 2.898 | 0.016 | - | **2.355** |
| **Sum (rounded down)** |  |  |  |  | **2.778** |

The cumulative ex-post emission reductions are calculated with the following calculation:

Where:

ERCO2,y CO2 emissions reductions in year y (tCO2)

ERCH4,y Methane emissions reductions in year y (tCO2)

Np,y Cumulative project operational rate included in the project database for project scenario p against baseline scenario b in year y

Up,y  Cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate (fraction)

The usage rate is used to discount the ERs and is calculated in section D.3. The next table shows the ER by month.

**Table 36: Emission reductions realised by the VPA 2**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Month of program | Period, begin and end date inclusive | | Cumulative number of units | Monthly ER  (tCO2e) | Cumulative ER  (tCO2e) |
| **49** | 01.01.21 | 31.01.21 | 4.730 | 1.087 | 1.087 |
| **50** | 01.02.21 | 28.02.21 | 4.791 | 1.101 | 2.188 |
| **51** | 01.03.21 | 31.03.21 | 4.846 | 1.114 | 3.301 |
| **52** | 01.04.21 | 30.04.21 | 4.916 | 1.130 | 4.431 |
| **53** | 01.05.21 | 31.05.21 | 5.003 | 1.150 | 5.581 |
| **54** | 01.06.21 | 30.06.21 | 5.133 | 1.180 | 6.760 |
| **55** | 01.07.21 | 31.07.21 | 5.319 | 1.222 | 7.982 |
| **56** | 01.08.21 | 31.08.21 | 5.553 | 1.276 | 9.258 |
| **57** | 01.09.21 | 30.09.21 | 5.706 | 1.311 | 10.570 |
| **58** | 01.10.21 | 31.10.21 | 5.971 | 1.372 | 11.942 |
| **59** | 01.11.21 | 30.11.21 | 6.189 | 1.422 | 13.364 |
| **60** | 01.12.21 | 31.12.21 | 6.266 | 1.440 | 14.804 |
| **Total** | | | | | **14,804** |

The table shows that the total number of ERs realized is **14,804tCO2**e.

**Table 37: Emission reductions realised by the VPA 2, per vintage**

|  |  |  |  |
| --- | --- | --- | --- |
| **Vintage** | **Start** | **End** | **Volume** |
| **2021** | 01/01/2021 | 31/12/2021 | 14,804 |
| **Total** | | | **14,804** |

**Revision History**

|  |  |  |
| --- | --- | --- |
| **Version** | **Date** | **Remarks** |
| 1.1 | 14 October 2020 | Hyperlinked section summary to enable quick access to key sections  Improved clarity on Key Project Information  Section for POA monitoring  Forward action request section  Improved Clarity on SDG contribution/SDG Impact term used throughout  Clarity on safeguard reporting  Clarity on design changes  Leakage section added for VER/CER projects  Addition of Comparison of monitored parameters with last monitoring period  Provision of an [accompanying Guide](https://globalgoals.goldstandard.org/standards/TGuide-PerfCert_V1.1-Monitoring-Report.pdf) to help the user understand detailed rules and requirements |
| 1.0 | 10 July 2017 | Initial adoption |

1. As per “20220201\_IDBP\_Database\_VPA2.xlsx”” | sheet 'Master VPA-2' | | cells M6707 to M6711

   Presented cumulative figures exclude the drop-off rate. [↑](#footnote-ref-1)
2. As per “20220201\_IDBP\_Database\_VPA2.xlsx”” | sheet 'Master VPA-2' | | cells Q6675 to Q6684 [↑](#footnote-ref-2)
3. As per “20220201\_IDBP\_Database\_VPA2.xlsx”” | sheet 'Master VPA-2' | | cells N6689 to N6696

   Figures may not add up due to rounding [↑](#footnote-ref-3)
4. As per “20220201\_IDBP\_Database\_VPA2.xlsx”” | sheet 'Master VPA-2' | cell L6699 [↑](#footnote-ref-4)
5. As per “20220201\_IDBP\_Database\_VPA2.xlsx”” | sheet 'Master VPA-2' | cell L6700 [↑](#footnote-ref-5)
6. As per Gold Standard confirmation by email, the parameter ‘t’ can be fixed at value 2.74 going forward to enable the definition of the VPA-2 threshold. See email communication dated 11 April 2016 [↑](#footnote-ref-6)
7. Methane has an energy value of 37.78 MJ/m3; thus, biogas at 55% CH4 has an energy value of 21 MJ/m3 [↑](#footnote-ref-7)
8. Cow dung produces approximately 40 litres biogas per kg. Each m3 capacity of the biodigester needs 7.5 kg dung per day. Given an average biodigester size of 4.26 m3, 36.600 kg of cow dung per day is required. This translates into approximately 1.46 m3 of gas produced per day. See Document P\_Biogas\_as\_renewable\_energy \_2005.pdf, pages 79 and 140. [↑](#footnote-ref-8)
9. Calculated as: 50% efficiency \* 21 MJ/m3 \* 1.46 m3/day [↑](#footnote-ref-9)
10. Figures may not add up due to rounding – see “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “Capacity calculation” | cell “C6” [↑](#footnote-ref-10)
11. Emission reduction of 2.355 tCO2e from methane avoidance by each digester was calculated by: subtracting from total Baseline Emissions from methane avoidance per household (BEb1,CH4,y), the total Project Emissions from methane avoidance per household (PEp1,CH4,y), plus total Project Emissions from bio-slurry (PEp1 bio-slurry), and total Leakage Emissions from methane avoidance per household (LEp1 CH4,y): See “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “GS VER 2021” | cell “E80” [↑](#footnote-ref-11)
12. The national office relates to the head quarter of IDBP located in Jakarta. From this office, all payments to CPOs for the confirmed biodigester constructions (as confirmed by the quality inspectors) are processed. These payments relate to the subsidy payments that CPOs receive for completed works. [↑](#footnote-ref-12)
13. Quality inspector is permanent staff of IDBP (8 staff). CPOs send completion reports to the database input. The database people coordinate with the finance department to release the payments to CPOs. Quality inspectors they verify that corrects inputs in database have been made. [↑](#footnote-ref-13)
14. The reason for the higher selection of hhs for the PFT (81) was that the PFT results are applicable to both VPA1 and VPA2, covering a total of nearly 25,000 biodigesters. The BFT was only applicable to VPA2, as for VPA1 BFT results have been fixed for the crediting period. For this reason, the sample size was reduced, but ensuring

    that the 90/30 level is met. [↑](#footnote-ref-14)
15. Please note that both VPAs only cover one user group type (i.e. households) and only small-scale digesters (i.e. max of 12m3). As such, sampling was done on the basis of this one user group only. Sampling approach for the BUS has remained unchanged since the past seven verifications. [↑](#footnote-ref-15)
16. Cluster sampling is applied to identify the geographical areas where the sampling is to take place. Multi-stage sampling is used to ensure that the random selection of households from each region is proportional to the overall population size of the population, while ensuring at least 30 hhs are covered from each age group. [↑](#footnote-ref-16)
17. “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | “Drop off” | Cells “C7” to “G7” [↑](#footnote-ref-17)
18. See <http://www.randomnumbergenerator.com/> [↑](#footnote-ref-18)
19. Where “Total approached” refers to the number of households reached during the BUS survey, and “Total completed” indicates the number of respondents that could complete the survey due to a functioning biodigester at that moment in time. Source: “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | “Drop off” | Cells “D36-57” to “H36-57” [↑](#footnote-ref-19)
20. [https://cdm.unfccc.int/Reference/Standards/meth/meth\_stan05.pdf](%20https://cdm.unfccc.int/Reference/Standards/meth/meth_stan05.pdf%20%20)  [↑](#footnote-ref-20)
21. There were no irregularities uncovered by the quality control performed by PT. RASA staff to confirm that the BUS surveys indeed had taken place. [↑](#footnote-ref-21)
22. A MC of 1 days (24 hour) is allowed by the Gold Standard. [↑](#footnote-ref-22)
23. Equivalent households is defined as a household with comparable characteristics as the selected project households in terms of the number of animals owned (at least two cows, or three pigs) and socio-economic characteristics (type of house). The selected baseline household may be slightly poorer as once they adopt a biodigester they often improve their livelihood. [↑](#footnote-ref-23)
24. WWF. Climate Change in Indonesia - Implications for Humans and Nature [↑](#footnote-ref-24)
25. Based on the 93 PFT KPT samples. See Biogas KPT & Non 2021.xls | sheet Biogas HH 2021 | cells P3 – P95 [↑](#footnote-ref-25)
26. Household Energy and Health Programme: Kitchen Performance Test. Available on:

    <https://cleancookstoves.org/binary-data/DOCUMENT/file/000/000/83-1.pdf> [↑](#footnote-ref-26)
27. Determining their eligibility to take part in the KPT. For instance no changes in the number of family members at the selected households, or no event or any other festive ceremonies scheduled during the test period. [↑](#footnote-ref-27)
28. For more on the Grubbs’ test, please refer to <http://www.itl.nist.gov/div898/handbook/eda/section3/eda35h1.htm>

    For a cross-check of the significance of the results, please refer to an online tool available on: <http://www.graphpad.com/quickcalcs/Grubbs1.cfm> [↑](#footnote-ref-28)
29. Note that all parameters collected from the BUS 2021 and the KPT 2021 are derived from a sample. All parameters derived from the IDBP Database are not based on a sample. [↑](#footnote-ref-29)
30. Lawrence Berkeley National Laboratory (2003) ‘Technical and Economic Performance Analysis of Kerosene Lamps and Alternative Approaches to Illumination in Developing Countries’ [↑](#footnote-ref-30)
31. Refer to accompanying GS Transition Annex for further details [↑](#footnote-ref-31)
32. As defined by the General Guidelines for Sampling and Surveys for Small-Scale CDM project activities, EB 50 Annex 30 [↑](#footnote-ref-32)
33. Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011), p.24 [↑](#footnote-ref-33)
34. Determining their eligibility to take part in the KPT. For instance no changes in the number of family members at the selected households, or no event or any other festive ceremonies scheduled during the test period. [↑](#footnote-ref-34)
35. See footnote 18 of the VPA-DD [↑](#footnote-ref-35)
36. See page 15 of the VPA-DD (table 4) [↑](#footnote-ref-36)
37. For calculation, refer to “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “Capacity calculation” [↑](#footnote-ref-37)
38. For calculation, refer to “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “GS VER 2021” | cell E90 [↑](#footnote-ref-38)
39. Technologies and practices to displace decentralized thermal energy – 11/04/2011’ p.11 - 12 [↑](#footnote-ref-39)
40. See: Biogas KPT & Non 2021.xls | sheet ’90-30 test’ | cells F50, I50, and L50 [↑](#footnote-ref-40)
41. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-41)
42. See: Biogas KPT & Non 2021.xls | sheet ’90-30 test’ | cells W103 and AC103 [↑](#footnote-ref-42)
43. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-43)
44. See “20220217 ER Calculation VPA2 MP5 CP1\_v03.”| sheet “GS VER 2021” | cell E77 [↑](#footnote-ref-44)
45. The methodology specifies the 90/15 rule but also the 90/30 rule. The GS confirmed that is should be 90/30 and that 90/15 is a typo. [↑](#footnote-ref-45)
46. <http://www.climatecare.org/media/documents/pdf/ClimateCare_Guidelines_for_Performance_Tests_and_KPTsx.pdf> [↑](#footnote-ref-46)
47. See: Biogas KPT & Non 2021.xls | sheet ’90-30 test’ | cells AN36 – AN40 [↑](#footnote-ref-47)
48. See: Biogas KPT & Non 2021.xls | sheet ’90-30 test’ | cells AN45 – AN49 [↑](#footnote-ref-48)
49. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-49)
50. IPCC Guidelines for National Greenhouse Gas Inventories (2006) ‘Chapter 10: Emissions from Livestock and Manure Management’ [↑](#footnote-ref-50)
51. <http://www.bmkg.go.id> [↑](#footnote-ref-51)
52. According to the BUS 2021, for 83% of households cows were the primary animals. For this reason, no other animals are included [↑](#footnote-ref-52)
53. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-53)
54. Source: “20220420 BUS\_Tabulation 2021\_v.01 | sheet Tabulation | cell AB119” [↑](#footnote-ref-54)
55. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-55)
56. According to the BUS 2021, for 83% of VPA-2 households cows were the primary animals. For this reason, no other animals are included [↑](#footnote-ref-56)
57. See “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “GS VER 2021” | cell E77 [↑](#footnote-ref-57)
58. See “20220217 ER Calculation VPA2 MP5 CP1\_v03.xls” | sheet “GS VER 2021” | cell E78 [↑](#footnote-ref-58)
59. Figures may not add up due to rounding – see sheet emission reduction calculation sheet [↑](#footnote-ref-59)
60. According to the BUS 2021, for 83% of VPA-2 households cows were the primary animals. For this reason, no other animals are included [↑](#footnote-ref-60)
61. Source: 20220420 BUS\_Tabulation 2021\_v.01 | sheet Tabulation | cell AB119 [↑](#footnote-ref-61)
62. P55 <http://www.lemvigbiogas.com/BiogasHandbook.pdf> [↑](#footnote-ref-62)
63. According to the BUS 2021, for 83% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included [↑](#footnote-ref-63)
64. The 55% digester efficiency features in the approved PoA-DD and VPA-DDs, and relates to http://www.lemvigbiogas.com/BiogasHandbook.pdf on which this figure has been based. [↑](#footnote-ref-64)
65. <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v1.pdf> [↑](#footnote-ref-65)
66. According to the BUS 2021, for 83% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MP5 [↑](#footnote-ref-66)
67. According to the BUS 2021, for 83% of VPA-2 households dairy cows were the primary animals. For this reason, no other animals are included in this MP5 [↑](#footnote-ref-67)
68. Source: “20220420 BUS\_Tabulation 2021\_v.01.xlsx” | sheet “Tabulation” | cells T317 to T321 [↑](#footnote-ref-68)
69. Figures may not add up due to rounding – see emission reduction calculation [↑](#footnote-ref-69)
70. Figures may not add up due to rounding [↑](#footnote-ref-70)