Component project activity design document form for CDM component project activities

(Version 05.0)

Complete this form in accordance with the Attachment "Instructions for filling out the component project activity design document form for CDM component project activities" at the end of this form.

COMPONENT PROJECT DESIGN DOCUMENT (VPA-DD)	
Title of the VPA	Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172), VPA-2 (GS 5303)
Version number of the VPA-DD	Version 1.0
Completion date of the VPA-DD	14/10/2016
Title of the PoA to which the VPA is included	Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172)
Host Party	Hivos Indonesia
Estimated amount of annual average GHG emission reductions	29,358
Applied methodology(ies) and, where applicable, applied standardized baseline(s)	Technologies and practices to displace decentralized thermal energy consumption (11/04/2011)
Sectoral scope(s) linked to the applied methodology(ies)	Scope 3

SECTION A. General description of VPA

A.1. Title of the proposed or registered PoA

>>
Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172)

A.2. Title of the VPA

>>
Indonesia Domestic Biogas Programme of Activities (IDBP) (ID 1172), VPA-2 (GS 5303)

A.3. Description of the VPA

>>
The IDBP started implementation of biodigesters on 24 October 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.

The second VPA (VPA-2) described in this VPA-DD targets the same programme and includes biogas digesters installed from 01/01/2017 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.

As the first VPA, VPA-2 covers the installation of fixed-dome type biodigesters of up to 12 m^3 in households that prior to the implementation of the project activity were using non-renewable biomass (NRB) and fossil fuels as their main source of cooking fuel. The biodigesters are fed with manure mixed with water, which undergo anaerobic digestion and produce biogas that is channelled directly to a cook stove. This biogas produced replaces the combustion of NRB and fossil fuels, thereby reducing carbon dioxide (CO_2) emissions. The biodigesters also reduce methane (CH_4) emissions by diverting manure that would otherwise decompose without the capture and use of the methane. The technical specification of the biodigester used in VPA-2 shall comply with the related technical requirement under IDBP, and is further outlined in Section A.5 of this PDD.

Table 1 below shows a tentative schedule for the implementation of this VPA. Biodigesters can be included in this VPA until the small-scale methodology threshold limit applicable under the CDM is reached[1]. This number is not known ex-ante, and the actual number of biodigesters will therefore be confirmed upon verification. This infers that the actual rate of implementation, as well as the resulting emission reduction potential, may deviate from the presented figures as long as all eligibility criteria of the VPA are met.

[1] Small-scale VPAs are subject to the thresholds set forth by the CDM; 15 MW (45 MW_{th}) for the renewable energy component and an emissions cap of 60,000 tCO_2e for the methane avoidance component

Table 1: Forecasted annual implementation schedule of VPA-2 (01/01/2017 – 31/12/2023)[2]

Period	Number of biodigesters in VPA-2 (cumulative)
01/01/2017 – 31/12/2017	3,000
01/01/2018 – 31/12/2018	6,000
01/01/2019 – 31/12/2019	9,500
01/01/2020 – 31/12/2020	13,000
01/01/2021 – 31/12/2021	16,500
01/01/2022 – 31/12/2022	20,000
01/01/2023 – 31/12/2023	0
	Total: 20,000

This VPA contributes to sustainable development in a number of ways:

(i) Environmental
- Reduced GHG emissions;
- Reduced deforestation and forest degradation in areas where NRB is used as a source of fuel. This contributes to the overall stability of forest ecosystems, which support biodiversity and watersheds;
- Improved soil conditions where digester slurry is applied to agricultural land[3].

(ii) Social
- Reduced combustion of firewood and fossil fuels reduces indoor air pollution, thereby increasing respiratory health of users, particularly women and children who spend a large portion of their time indoors[4].

(iii) Economic
- Reduced end-user expenses due to reduced expenses on the purchase of biomass and fossil fuels, as well as healthcare related expenses;
- The use of the slurry as an organic fertiliser on agricultural soils can significantly improve soil quality and offset costs that would otherwise be incurred in the purchase of chemical fertilisers. The nutrient value of the slurry produced has also been shown to be higher than raw manure[5].

A.4. Entity/individual responsible for the operation of VPA

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The individuals responsible for the biodigesters are individual owners of the biogas equipment. Each biodigester owner agrees by a 'Household Agreement' to transfer the ownership title of the generated emission reductions to the VPA implementer.

The implementing entity of this VPA is Hivos Indonesia, which is also the CME of the programme.

A.5. Technical description of the VPA

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The technology implemented under this VPA covers biodigesters fed with a mixture of water and animal manure that is anaerobically digested. The capacity of the biodigesters ranges from 4 m^3 to 12 m^3, below the capacity threshold imposed by the applicable methodology. The generated biogas is intended for use as fuel for cooking. This VPA targets the implementation of fixed-dome

[2] Note that more biodigesters can be added as long as the small-scale methodology threshold limit applicable under the CDM is respected. This means that the actual implementation schedule may deviate from the stated figures, and the VPA may include units constructed post-2020

[3] Lukehurst, C.T., Frost, P. and Al Seadi, T (2010) 'Utilisation of digestate from biogas plants as biofertiliser'. IEA Bioenergy

[4] World Health Organization (2007) 'Indoor Air Pollution - National burden of Disease Estimates'. Geneva.

[5] Lukehurst, C.T., Frost, P. and Al Seadi, T (2010) 'Utilisation of digestate from biogas plants as biofertiliser'. IEA Bioenergy

biodigesters (see Figure 1). This model is constructed with bricks and stone masonry. The fixed-dome technology has a proven durability, and can be installed underground, saving space and protecting the installation. Materials for its construction can be sourced locally.

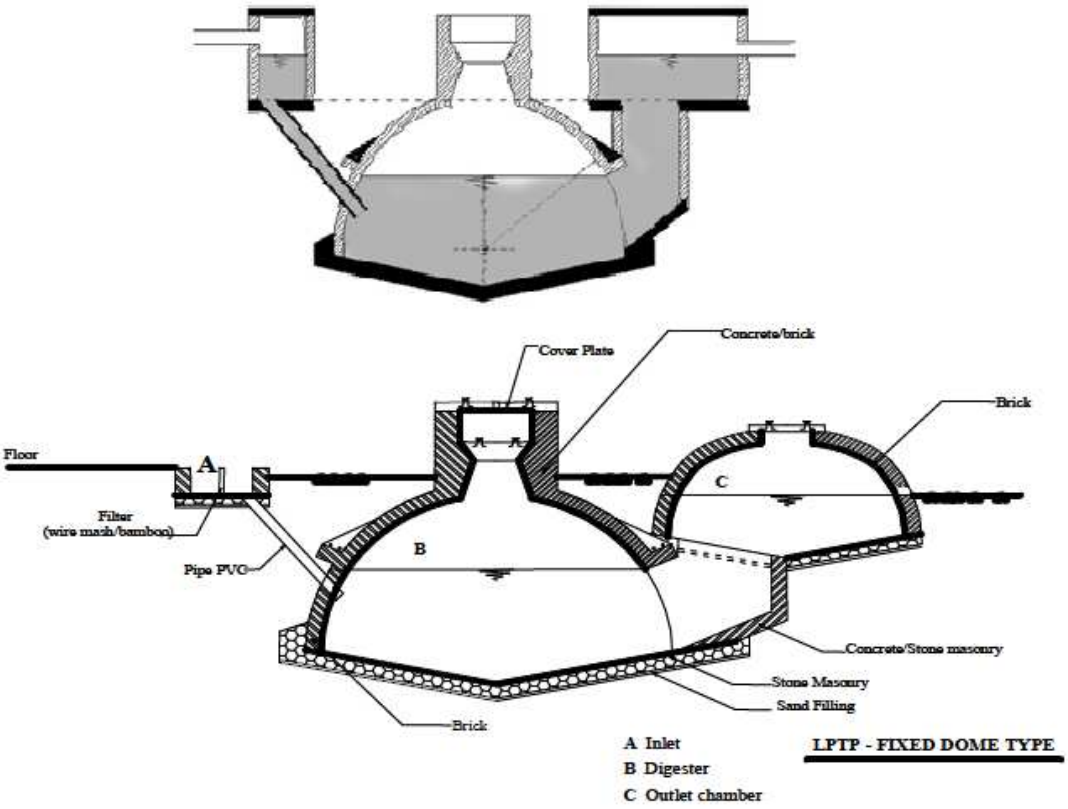
The use of the fixed-dome biodigester model is simple:

1. Collect manure and mix with water;
2. Feed this mix into the biodigester;
3. Both biogas and sludge are produced.

The biogas is used as cooking fuel. The build-up of gas will push out slurry through the exit pipe of the biogas system, and is a fertiliser that can either be applied directly to crops or composted with other organic material.

Maintenance needs are limited since the biodigester has no moving parts. Over time, some indigestible material can build up in the digester, limiting the reactor volume. This issue is solved simply by scooping the indigestible material out and re-filling the biodigester with manure.

Figure 1: Graphic representation of the applied fixed-dome biodigester model.



A.6. Party(ies)

Name of Party involved (host) indicates host Party	Private and/or public entity(ies) VPA implementer(s) (as applicable)	Indicate if the Party involved wishes to be considered as VPA implementer (Yes/No)
Indonesia (host)	Hivos	No
Netherlands	Hivos	No

A.7. Geographic reference or other means of identification

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The geographic boundary for the VPA is the Republic of Indonesia.

Figure 2: Map of the Republic of Indonesia.

All of the biodigesters implemented under this VPA will have a unique serial number that will be recorded in the CME's database. Each entry will be clearly divided and it will not be possible to make the same serial number entry twice. The numbers will be recorded in the User's Manual that will enable the verifier to identify systems listed in the database. The database will further include information regarding the address of the installed biodigester, information on the owner, and its operational status.

The geographical coordinates of the provinces in which biodigesters under this VPA are implemented are as follows:

Table 2: Geographical boundary of VPA-2

Province	Latitude	Longitude
Lampung	4.5586° S	105.4068° E
West Java	7.0909° S	107.6689° E
Central Java and Yogya	7.1510° S	110.1403° E
East Java	7.5361° S	112.2384° E
Bali	8.3405° S	115.0920° E
Nusa Tenggara Barat	8.6529° S	117.3616° E
Nusa Tenggara Timur	8.6574° S	121.0794° E
Sumba	9.6993° S	119.9741° E
South Sulawesi	3.6688° S	119.9741° E
South East Sulawesi	3.5562° S	121.8020° E
Jambi	1.6101° S	103.6131° E

A.8. Duration of the VPA

A.8.1. Start date of the VPA

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The starting date of this VPA is 01/01/2017.

A.8.2. Expected operational lifetime of the VPA

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The expected operational lifetime of the VPA is 21 years.

A.9. Choice of the crediting period and related information

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Renewable.

A.9.1. Start date of the crediting period

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The start date of the crediting period of this VPA is 01/01/2017.

A.9.2. Length of the crediting period

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The crediting period for the VPA is 7 years, renewable twice. The duration of the crediting period will not exceed the end date of the programme.

A.10. Estimated amount of GHG emission reductions

Emission reductions during the crediting period	
Years	**Annual GHG emission reductions (in tonnes of CO_2e) for each year**
01/01/2017 – 31/12/2017	3,662
01/01/2018 – 31/12/2018	11,651
01/01/2019 – 31/12/2019	20,251
01/01/2020 – 31/12/2020	29,572
01/01/2021 – 31/12/2021	38,893
01/01/2022 – 31/12/2022	48,214
01/01/2023 – 31/12/2023	53,263
Total number of crediting years	7
Annual average GHG emission reductions over the crediting period	**29,358**
Total estimated reductions (tonnes of CO_2e)	205,508

A.11. Public funding of the VPA

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The VPA is supported through public funding from a number of sources. Most notable is the contribution from the Government of the United States, which channels finance through the Millennium Challenge Programme. A trustee institution formed by the Government of Indonesia (MCA Indonesia) acts as the implementer of aid programme. Another co-funder of the VPA is Energising Development (EnDev). EnDev is an energy access partnership currently financed by seven donor countries: the Netherlands, Germany, Norway, Australia, United Kingdom, Switzerland and Sweden.

The carbon credits to be generated by the VPA shall not be transferred, directly or indirectly, to meet GHG reduction requirements of any of the stated parties involved. The VPA is located in Indonesia,

which is part of the OECD Development Assistance Committee's ODA recipient list.[6] A written declaration of IDBP's non-use of ODA has been issued and submitted to the Gold Standard Foundation, attached in the annex of this PDD.

A.12. Confirmation for VPA

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The installation and commissioning procedure outlined in Section A.4.4.1 of the GS VER PoA-DD ensures that all necessary data are gathered. Double counting is avoided through recording the unique serial number of each biodigester in a centralised database system operated by the CME. Participating users will confirm that they are not taking part in other registered PoAs through signing of a Household Agreement for each biodigester.

A.13. Contact information of responsible persons/ entities for completing the CDM-VPA-DD-FORM

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Climate Focus B.V.
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SECTION B. Environmental analysis

B.1. Analysis of the environmental impacts

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An environmental impact assessment is not required for activities implementing household biodigesters in Indonesia, as stipulated by Law no. 32/2009 on Environment Protection and Management (RPPLH, 3 October 2009).

B.2. Environmental impact assessment

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1. Environmental Analysis is done at PoA level ☒
2. Environmental Analysis is done at SSC-VPA level ☐

SECTION C. Local stakeholder consultation

C.1. Solicitation of comments from local stakeholders

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This information is provided at the PoA level. Please refer to Section D of the GS-PoA-PDD.

There are four reasons why the stakeholder consultation was performed at the PoA level instead of the project activity level:

- *Identical geographical boundary:* Each VPA under the programme may include biodigesters which are implemented anywhere within the national boundaries of the Republic of Indonesia;
- *Identical technology:* All of the project activities implemented under the programme will implement a biodigester system. The particular size of the biodigester system will be determined

[6] OECD (2011) 'DAC List of ODA Recipients' Available at: ht6tp://www.oecd.org/dataoecd/32/40/43540882.pdf

on the user level and is contingent upon the user size and number of animals kept. This is independent from VPAs, which are implemented nationwide and need to adhere to the small-scale thresholds set forth by the CDM;

- *Similar time frame:* VPAs will be included consecutively given the programme anticipated implementation schedule;
- *Similar socio-economic situation:* The programme targets users that breed cattle or other farm animals and act as individual farmers form part of a cooperative (local community), or run SMEs. The users are in a similar socio-economic situation and can be classified as belonging to the low income class, typically residing in rural areas.

C.2. Summary of comments received

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This information is provided at the PoA level. Please refer to Section D of the GS-PoA-PDD.

C.3. Report on consideration of comments received

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This information is provided at the PoA level. Please refer to Section D of the GS-PoA-PDD.

SECTION D. Eligibility of VPA and estimation of emissions reductions

D.1. Reference of methodology(ies) and standardized baseline(s)

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

D.2. Applicability of methodology(ies) and standardized baseline(s)

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The VPA applies all baseline and monitoring procedures according to the guidelines laid out in the methodology entitled 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (11/04/2011).

This methodology is applicable to programs or activities introducing technologies and/or practices that reduce or displace greenhouse gas (GHG) emissions from the thermal energy consumption of households, communities and SMEs. This includes biodigesters.

To be eligible, the following applicability criteria apply:

Applicability criteria	Justification
1. Clearly identifiable project boundary: The project boundary can be clearly identified, and the biodigesters counted in the project are not included in another voluntary market or CDM project activity (i.e. no double counting takes place). Project proponents must have a survey mechanism in place together with appropriate mitigation measures so as to prevent double-counting in case of another similar activity with some of the target area in common.	The project boundary is the physical, geographical site of the methane recovery and combustion systems The mitigation measures to prevent double-counting are presented in Appendix 5 of this VPA-DD.
2. Limited level of energy output per biodigester: The biodigesters each have continuous useful energy outputs of less than 150 kW_{th} per unit (defined as total energy delivered usefully from start to end of operation of a unit divided by time of operation).	The maximum energy output of the biodigesters implemented in the project activities is 3.83 kW_{th}, below the indicated 150 kW_{th} limit per unit.

	See calculation presented in Table 3 below.
3. Continued use of baseline technology: The use of the baseline cook stoves as a backup in parallel with the new, biogas fueled cook stoves introduced by the project activity is permitted as long as a mechanism is put into place to encourage the removal of the old technology and the definitive discontinuity of its use. The project documentation must provide a clear description of the approach chosen and the monitoring plan must allow for a good understanding of the extent to which the baseline cook stove is still in use after the introduction of the improved technology. The success of the mechanism put into place must therefore be monitored, and the approach must be adjusted if proven unsuccessful.	An annual Biogas User Survey (BUS) implemented as part of the monitoring activities collects information on the continued usage of the baseline technology. A bi-annual Project Performance Field Test (PFT) is implemented to quantify the amount of baseline fuel still applied in the project scenario. See Section D.7.2 of this VPA-DD for more information on the approach.
4. Settling of ownership rights over generated emission reductions: The project proponent must clearly communicate to all project participants two whom the ownership rights of the emission reductions resulting from the project activity belong. This must be communicated to the technology producers and the retailers of the by contract or clear written assertions in the transaction paperwork.	As set out in the operational and management plan featured in Appendix 5 of this VPA-DD., each end users of a biodigester will be asked to read and sign a contract stating that they agree to transfer the ownership rights of the emission reductions generated by the biodigester technology to Hivos, the CME of the programme. Copies of these signed contracts will be kept by the CME.
5. Use of new biomass feedstock Project activities making use of a new biomass feedstock in the project situation (e.g. shift from non-renewable to green charcoal, plant oil or renewable biomass briquettes) must comply with relevant Gold Standard specific requirements for biomass related project activities, as defined in the latest version of the Gold Standard rules.	This applicability criterion is not applicable as no new biomass feedstock is used in the project scenario.
6. Climate zones If more than one climate zone is included in the project activity, a distinction per climate zone must be considered. The distinct geographical boundary of each project area must be clearly documented in the project documentation, using representative GPS data.	This applicability criterion is not applicable as Indonesia constitutes one climate zone. All of Indonesia falls in the Tropical Zone.[7]

The largest biodigester type implemented in this VPA, the 12 m^3 unit, is estimated to produce up to 3.6 m^3 of biogas per day. This amounts to a maximum output of 3.83 kW_{th}, which is below the established threshold of 150 kW_{th}. The calculation is presented below:

Table 3: Maximum thermal capacity of biodigester implemented under VPA-2

$\mathbf{Th_{cap}} = \frac{\mathbf{E}}{\mathbf{t}}$ $\quad where \quad \mathbf{E} = \eta * H_b * V_b$		
Where:	Value:	Comments:
t = hours/day usage	2.74	IDBP Biogas User Survey, 2016
η = efficiency of stove	50%	Indonesian Government standard on stove efficiency

[7] As per the Köppen Climate Classification System, a widely used classification system of the world's climates

H_b = heat of combustion per unit volume of biogas	21.0 MJ/m[3][8]	Derived from IPCC defaults
V_b = volume of biogas	3.6 m[3]/day[9]	Data provided by Hivos
E = Energy available from the biogas system	37.8 MJ/day	Calculated
E_{th} =	10.5 kWh/day	1 MJ = 0.2778 kWh
Th_{cap} =	3.83 kW_{th}	Given a 2.74 hour/day usage

The above calculation also proves that VPA-2 can be deemed automatically additional, as per paragraph 2 of the Guidelines on the Demonstration of Additionality of Small-Scale Project Activities' (EB68 Annex 27, version 09.0) referred to in Section E.5.1 of the PoA-DD.

As defined in paragraph 2 of the referred guidance document, the documentation of barriers, as per paragraph 1 of the guidance, is not required for a positive list of technologies and project activity types that are defined as automatically additional for project sizes up to and including the small-scale CDM thresholds. Paragraph 2 c is applicable to this VPA-2. It states the condition:

"Project activities solely composed of isolated units where the users of the technology/measure are households or communities or Small and Medium Enterprises (SMEs) and where the size of each unit is no larger than 5% of the small-scale CDM thresholds. This size limitation translates into units under 750 kW installed capacity or under 3000 MWh of energy savings per year or 3000 tonnes of emission reductions per year."

This VPA successfully demonstrates compliance with the indicated size limit and is thereby defined as additional.

D.3. Sources and GHGs

In the baseline scenario CO_2 and CH_4 are released into the atmosphere. The burning of biomass and fossil fuels for cooking purposes is responsible for CO_2 emissions, while baseline manure handling practices cause CH_4 emissions from anaerobic decomposition. In the project scenario, CH_4 from the physical leakage of the biodigesters and the CO_2 emissions from the continued use of fuels in the project activity need to be accounted for. Emission sources and GHGs within the boundary of the VPA are outlined below:

[8] Methane has an energy value of 37.78 MJ/m[3]; thus, biogas at 55% CH_4 has an energy value of 21 MJ/m[3]

[9] Cow dung produces approximately 40 litres biogas per kg. Each m[3] capacity of the biodigester needs 7.5 kg dung per day. Given a 12 m[3] biodigester, 90 kg of cow dung per day is required. This translates into 3.6 m[3] of gas produced per day.

Source		GHGs	Included?	Justification/Explanation
Baseline scenario	Heat delivery	CO_2	Yes	CO_2 emissions from - fossil fuel cook stoves - cook stoves using non-renewable biomass
	Treatment of manure	CH_4	Yes	CH_4 emissions from the baseline treatment methods of manure
		N_2O	No	Insignificant
Project scenario	Heat delivery	CO_2	Yes	Continued CO_2 emissions from - fossil fuel cook stoves - cook stoves using non-renewable biomass
	Treatment of manure	CH_4	Yes	Emissions due to physical leakage of methane from the biodigester, as well as emissions due to the manure not fed into the biodigester, as per the applied methodology
		N_2O	No	Insignificant

D.4. Description of the baseline scenario

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The baseline scenario is composed of three components. All three components are covered by the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (11/04/2011), and include the following:

i. Consumption of non-renewable biomass for cooking.

Dependency on firewood and charcoal as a source of thermal energy for cooking purposes is high in Indonesia.[10] The usage of NRB (including charcoal) contributes to deforestation and forest degradation and results in emission of GHGs. The applicable methodology states that the baseline scenario is, in the absence of the project activity, the use of NRB meeting similar thermal energy demands.

ii. Consumption of fossil fuel for cooking.

Dependency on fossil fuels as a source of thermal energy for cooking purposes, especially kerosene and LPG, is also significant in Indonesia. The combustion of fossil fuels for cooking results in emission of GHGs. The applicable methodology states that the baseline scenario is, in the absence of the project activity, the use of fossil fuels meeting similar thermal energy demands.

iii. Methane emissions from manure handling.

The baseline scenario is the situation where, in the absence of the project activity, organic matter is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. The amount of methane that is emitted under this scenario is contingent upon the baseline manure management practice, which can include storing manure in anaerobic lagoons, deep pits, liquid storage, deep bedding, or other practices outlined in the '2006 IPCC Guidelines for National Greenhouse Gas Inventories'[11]. The applicable methodology establishes that baseline emissions are calculated by using the amount of the waste that would decay anaerobically in the absence of the project activity, with the most recent IPCC Tier 1 or 2 approaches[12].

[10] Laboratory of Energy and Agricultural Electrification (2002) 'Biomass energy potentials and utilisation in Indonesia'

[11] See chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[12] See chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories

D.5. Demonstration of eligibility for a VPA

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The VPA shall meet both the general eligibility criteria and sustainable development listed in Tables 4 and 5 respectively to become eligible for inclusion in this PoA:

Table 4: General eligibility criteria for the inclusion of the VPA

General Eligibility Criteria		Yes/No?	Confirmation
1	All biogas systems listed in the VPA are installed within the geographical boundaries of Indonesia. Each biodigester in the VPA has a unique serial number that is recorded in the User's Manual and/or engraved or permanently attached as a nameplate which confirms the location of the biodigester. The serial numbers are listed in the IDBP database.	☒ Yes ☐ No	VPA-2 boundary is Indonesia and all biodigesters are located within Indonesia (see Section A.7) Verifiable evidence: - IDBP Database
2	The technology used consists of biodigesters of capacity no more than 100 m^3. Furthermore, the specific construction quality standards enforced by the IDBP will need to be met by each unit commissioned.	☒ Yes ☐ No	The technology used in VPA-2 is biodigesters. The maximum capacity of the installed is 12 m^3, below the identified threshold (see Section D.2). All biodigesters meet the 57 quality construction standards required by the programme. Verifiable evidence: - Completion Report - Household Agreement - IDBP Database
3	There are three distinct groups of users targeted under this PoA: 1) Households: Individual houses inhabited by dairy farmers or other types of farmers. 2) Communities: Aggregation of individuals living or meeting in a particular place or area, such as schools, farmer communities, or other social venues. 3) SMEs: Domestic firms with an annual turnover of up to 300 million Rupiah, as defined by the Indonesian Law of Micro, Small and Medium Enterprises from 2008.[13]	☒ Yes ☐ No	The target users in VPA-2 are households (see Section A.2). Verifiable evidence: - Household Agreement
4	Each user group as defined in Eligibility Criterion 3represents a separate baseline scenario, the baseline conditions for which will be defined on the VPA level.	☒ Yes ☐ No	The target users in VPA-2 are households (see Section A.2). Verifiable evidence: - Baseline survey

[13] Indonesian Law No.20 on Micro, Small and Medium Enterprises (2008)

5	The biodigesters are uniquely identified and defined in an unambiguous manner by providing the serial number of the systems installed.	☒ Yes ☐ No	The IDBP database managed by the CME lists the serial numbers of all systems installed in VPA-2. Verifiable evidence: - IDBP Database - Completion Report - Household Agreement
6	The biodigesters each have continuous useful energy outputs of less than 150kW_{th} per unit (defined as total energy delivered usefully from start to end of operation of a unit divided by time of operation).	☒ Yes ☐ No	The maximum capacity of the installed is 12 m^3, which corresponds to a thermal capacity of 3.83 kW_{th} (see Section D.2). Verifiable evidence: - Completion Report - Household Agreement - IDBP Database
7	The VPA follows the baseline and monitoring methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' and should meet its eligibility criteria as discussed in section E.2 of the PoA-DD.	☒ Yes ☐ No	VPA-2 uses the applicable methodology and meets the eligibility criteria as discussed in section E.2 of the PoA-DD. Verifiable evidence: - Completion Report - Household Agreement
8	Confirmation that the VPA, and any of its biodigesters, is/are not registered/being registered as a standalone CDM or voluntary project, or as part of another registered PoA.	☒ Yes ☐ No	Each participant to VPA-2 has confirmed in writing that they transfer the title to the emission reductions to the VPA-2 implementer, which is Hivos. Verifiable evidence: - Household Agreement
9	The VPA crediting period shall be confined within 28 years after the date of PoA registration.	☒ Yes ☐ No	The crediting period of VPA-2 is 7 years, renewable twice. Given anticipated inclusion only five years after registration of the PoA under the Gold Standard, the VPA-2 crediting date does not exceed 28 years after the date of PoA registration. Verifiable evidence: - IDBP Database
10	Any Official Development Assistance received for the VPA has not occurred on the	☒ Yes ☐ No	See Appendix 2 of this VPA-DD for confirmation.

	condition that the resulting credits are transferred to the donor country[14].		Verifiable evidence: - ODA Declaration
11	Confirmation that the VPA will adhere to the conditions related to sampling requirements established for the PoA.	☒ Yes ☐ No	See Section D.7 of this VPA-DD for confirmation. Verifiable evidence: - Biogas User Survey (2012)
12	The VPA is additional according to the criteria in section E.5.1. of the PoA-DD.	☒ Yes ☐ No	Verifiable evidence: See Section D.2 of this VPA-DD for confirmation.
13	Confirmation that the VPA does not receive Green or White certificates, or the equivalent under any scheme, as required by the Gold Standard[15].	☒ Yes ☐ No	The VPA does not receive any certificates that would constitute double counting upon issuance of carbon credits under the Gold Standard. Verifiable evidence: - Declaration from the VPA Implementer
14	The VPA implementer must clearly communicate to all participants to whom the ownership rights of the emission reductions resulting from the project activity belong. The transfer of the ownership rights should be confirmed in writing.	☒ Yes ☐ No	See Section D.7 of this VPA-DD for confirmation. Verifiable evidence: - Household Agreement
15	The start date of the VPA will be on or after the start date of the PoA. The start date of the VPA will be defined as the date on which the first Household Agreement is signed under the VPA.	☒ Yes ☐ No	The start date of this VPA is 01/01/2017, while the registration date of the PoA is 31/05/2013. Verifiable evidence: - IDBP Database - Household Agreement
16	A Local Stakeholder Consultation has been carried out on Host Country level. An additional Local Stakeholder Consultation session will be carried out when the PoA starts including VPAs with biodigesters exceeding 12m^3. An environmental impact assessment (EIA) has been carried out for the VPA, or evidence is provided that the programme activities are exempt from an EIA.	☒ Yes ☐ No	A Local Stakeholder Consultation has been carried out on Host Country level, as per the Local Stakeholder Consultation report. All digesters in the VPA are below 12m^3. Verifiable evidence: - Stakeholder Consultation Report - EIA exemption proof has been provided.
17	Small-scale VPAs are subject to the thresholds set forth by the CDM; 15 MW (45 MW_{th}) for the renewable energy component and an emissions cap of 60,000 tCO_2e for the methane avoidance component.	☒ Yes ☐ No	VPA-2 is a small-scale VPA. The maximum biodigester size of VPA-2 is 12 m^3. Data from VPA-1 shows that the actual

[14] Gold Standard Toolkit, Version 2.1, Section 1.2.5.

[15] Gold Standard Toolkit, Version 2.1, Section 1.2.7.

			average biodigester size is 6.12 m^3, which equites to an average thermal output of 1.96 kW_{th} per unit, as per the formula in Section D.2 this VPA-DD.[16] Given there are a total of 20,000 units forecasted to be implemented in the VPA, this amounts to 39.2 MW_{th} in total, below the 45 MW_{th} threshold for the renewable energy component.[17] The emission reduction potential of methane avoidance per biodigester is 1.50 tCO_2e. Given 20,000 units installed in the VPA, this amounts to 30,000 tCO_2e in total, below the 60,000 tCO_2e threshold for the methane avoidance component.

Table 5: Sustainable development criteria for the inclusion of the VPA.

Sustainable Development Criteria	Explanation	Yes/No?	Confirmation
Social Development			
Soil condition	The VPA will lead to an improvement in local soil condition as the application of the biodigester slurry increases the organic content and fertility of soils, thereby increasing crop yields. The VPA will encourage the application of the slurry of land and will monitor the application of the final biodigester slurry on agricultural land.	☒ Yes ☐ No	The VPA actively supports the application of the slurry on agricultural land. The VPA dedicated staff responsible for educating users on the benefits and application of the slurry, and many farmers are using it to fertilise crops. Verifiable evidence: - Biogas User Survey
Quality of employment	The VPA will install a large number of biodigesters which require constructing and monitoring effort by local staff. The VPA will create quality, job opportunities. All staff will be supported by vocational training sessions supported by the programme. On completion of these trainings, all attendees will	☒ Yes ☐ No	The VPA provides trainings and provides certification to trained individuals through the programme. As the VPA grows through time, the creation of quality employment opportunities will grow.

[16] See results presented in Monitoring Report III of VPA-1

[17] Calculated as 1.96 * 20,000 = 39.2 MW_{th}.

	receive a certificate proving their attendance and skills gained. Furthermore, as part of the trainings, all staff will undergo a Health and Safety training.		Verifiable evidence: - IDBP Database
Livelihood of the poor	The VPA will improve the livelihood of the poor through reducing user energy costs in the long term and freeing up time for other income generating activities through a reduced need to spend time collecting firewood. The project activity shall also help to promote gender equality through the active employment of women. This will also benefit the programme as a whole since women, as the primary users of cooking fuels, will be more effective at marketing the biogas installations, and associated cook stoves, to other women. The VPA shall also benefit the quality of life of the poor, particularly women and children, through improved health (less smoke inhalation), less time spent on cleaning soot from the user, collecting fuel and cooking. This will free up time for other activities.	☒ Yes ☐ No	The VPA implements biodigesters which through the reduction of user energy costs in the long term improve the livelihood of the poor. Gender benefits are highlighted by the results of the latest Biogas User Survey, further implying improvement in the livelihood of the poor. Verifiable evidence: - Biogas User Survey
Access to affordable and clean energy services	The VPA shall improve user's access to safe and affordable energy. Biogas fuel shall be available at the simple turn of a knob, requiring no laborious collection of fuel and no additional costs beyond initial setup other than for maintenance. As long as the manure digester is used and maintained properly, a secure supply of biogas will be provided in each project activity.	☒ Yes ☐ No	The VPA implements biodigesters which deliver clean energy to the households. Verifiable evidence: - IDBP Database
Human and institutional capacity	The VPA shall offer vocational training to engaged staff on the marketing, installation and maintenance of the biodigesters. Women will be especially encouraged to take up roles in marketing, where their experiential expertise will be particularly beneficial to the success of the programme as a whole. Women, as the primary users of the technology, will be more effective at marketing the product to other women. Less time spent on	☒ Yes ☐ No	The VPA offers vocational training to constructors and ensures both males and females receive equal opportunities to join the programme by having specific gender-driven employment targets in place. Verifiable evidence: - IDBP Database - Biogas User Survey

	firewood collection, user cleaning and cooking will also allow more time to be available for other activities, such as greater school attendance due to the reduced domestic responsibility of children.		
Economic and technological development			
Quantitative employment and income generation	The construction and maintenance of biodigesters in the VPA shall result in the creation of employment opportunities nationwide. By stimulating this new business sector, the VPA will therefore also create opportunities for entrepreneurs to enter the market.	☒ Yes ☐ No	The VPA creates employment opportunities and provides trainings. As the VPA grows through time, the quantitative employment rate will increase. Verifiable evidence: - IDBP Database - Biogas User Survey
Technology transfer and technological self-reliance	The VPA will hire and train local contractors and constructors, thereby transferring technological capacity to local companies allowing them to further offer services in future. The biodigesters will be constructed using locally available materials. As part of the programme, the VPA will openly engage local communities in their activities, including offering training on installation and maintenance of biodigesters. Each VPA will also involve 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.	☒ Yes ☐ No	Through training of local constructors, technological capacity gained from abroad is transferred into the domestic market, building the foundation for a sustainable biogas market in Indonesia. Verifiable evidence: - IDBP Database - Biogas User Survey

D.6. Estimation of emission reductions

D.6.1. Explanation of methodological choices

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The programme applies all baseline and monitoring procedures according to the guidelines laid out in the methodology entitled 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (11/04/2011).

This methodology is applicable to programs or activities introducing technologies and/or practices that reduce or displace greenhouse gas (GHG) emissions from the thermal energy consumption of households, communities and SMEs. This includes biodigesters.

D.6.2. Data and parameters fixed ex-ante

Data / Parameter	$f_{NRB,y}$
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: $f_{NRB,y} = \frac{NRB}{NRB+DRB}$
Purpose of data	For the calculation of the fraction of non-renewable biomass
Additional comment	-

Data / Parameter	**NRB**
Unit	m^3
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 m^3 from B_y of 86,396,000 m^3. B_y is the amount of firewood removed from forests which amounts to 86,396,000 m^3 (FAO, 2010).
Purpose of data	For the calculation of the fraction of non-renewable biomass
Additional comment	-

Data / Parameter	**DRB**
Unit	m^3
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 m^3, in line with 35,378,000 m^3 estimated by ITTO (2009). The more conservative number 35,490,000 m^3 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 m^3.
Purpose of data	For the calculation of the fraction of non-renewable biomass

Additional comment	-

Data / Parameter	**$EF_{b1, bio}$**
Unit	tCO_2/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. CO_2 and non-CO_2 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	**$EF_{p1, bio}$**
Unit	tCO_2/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 comment	IPCC (2006); May be updated according to any future changes by the IPCC.

Data / Parameter	**NCV_{bio}**
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 comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	$EF_{b1, fuel}$
Unit	tCO_2/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 comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	$EF_{p1, fuel}$
Unit	tCO_2/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 comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	NCV_{fuel}
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 comment	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter	$\eta_{biogas\ stove}$
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 comment	-

Data / Parameter	**$EF_{awms,T}$**
Unit	kg CH_4
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 comment	IPCC (2006); May be updated according to any future changes by the IPCC.

D.6.3. Ex-ante calculation of emission reductions

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i. Accounting for emission reductions due to the displacement of fossil fuels and non-renewable biomass[18].

Emission reductions:

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:

$$\mathbf{ER_{CO2,y}} = \sum_{b1,p1} N_{p1,y} * U_{p1,y} * \left(f_{NRB} * ER_{b1,p1,y,CO2} + ER_{b1,p1,y,non-CO2}\right) - \sum LE_{p1,y} \quad \textbf{(1)}$$

Where:

[18] CO_2 and non-CO_2 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.

$ER_{CO2,y}$ Cumulative CO_2 emission reductions from the substitution of non-renewable biomass and fossil fuels

$\sum_{b1,p1}$ Sum over all relevant (baseline b1/project p1) couples

$N_{p1,y}$ Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

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

$ER_{b1,p1,y,CO2}$ Specific CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, in tCO_2/year, and as derived from the statistical analysis of the data collected from the field tests

$ER_{b1,p1,y,non\text{-}CO2}$ Specific non-CO_2 emission savings for an individual technology of project p1 against an individual technology of baseline b1 in year y, converted in tCO_2/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

$LE_{p1,y}$ Leakage for project scenario p1 in year y (tCO_2e/yr)

As there is one common baseline scenario and one type of technology applied, and specific non-CO_2 emission savings are treated in a separate equation (equation **7** onwards), the VPA-2 can apply the following formula for calculating emission reductions:

$$\sum \mathrm{ER}_{\mathrm{CO2,y}} = (\sum \mathrm{BE}_{\mathrm{b1,CO2,y}} - \sum \mathrm{PE}_{\mathrm{p1,CO2,y}} - \sum \mathrm{LE}_{\mathrm{p1,CO2,y}}) * \mathrm{N}_{\mathrm{p1,y}} * \mathrm{U}_{\mathrm{p1,y}} \quad \textbf{(2)}$$

Where:

$\sum ER_{CO2,y}$ Cumulative CO_2 emission reductions from the substitution of non-renewable biomass and fossil fuels

$\sum BE_{b1,CO2,y}$ Cumulative baseline emissions as calculated below under formula (**3**)

$\sum PE_{p1,CO2,y}$ Cumulative project emissions as calculated below under formula (**4**)

$\sum LE_{p1,CO2,y}$ Cumulative leakage as per methodology guidance[19]

$N_{p1,y}$ Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

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

Baseline emissions:

The baseline scenario for VPA-2 is defined by the baseline fuel consumption patterns in a household population that is targeted for adoption of the biodigester technology. In addition to the defined pre-project situation, the methodology allows for a baseline scenario to be assessed in terms of supressed demand if adequate evidence is provided that in the baseline scenario the target population consumes less fuel than would satisfy their human development needs. As households

[19] Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011) p.11 - 12

are the target group of this VPA, baseline #1 is referred to in the formulas, as per Eligibility Criterion 3 of the PoA-DD. The following formula calculates the baseline emissions per household:

$$BE_{b1CO2,y} = \sum_b BB_{b1,fuel} * NCV_{fuel} * EF_{b1,fuel}) + (BB_{b1,bio} * NCV_{bio} * EF_{b1,bio} * f_{NRB}) \quad \textbf{(3)}$$

Where:

$BE_{b1,CO2,y}$	Cumulative baseline CO_2 emissions from the use non-renewable biomass and fossil fuels at households during year y
$BB_{b1,fuel}$	The quantity of fossil fuel consumed in the baseline scenario 1, in tonnes/year
NCV_{fuel}	Net calorific value of fossil fuel, in TJ/tonne
$EF_{b1,fuel}$	CO_2 emission factor of fossil fuel in baseline scenario 1, in tonnes/TJ
$BB_{b1,bio}$	The quantity of biomass consumed in the baseline scenario 1, in tonnes/year
NCV_{bio}	Net calorific value of biomass, in TJ/tonne
$EF_{b1,bio}$	CO_2 emission factor of biomass in baseline scenario 1, in tonnes/TJ
f_{NRB}	Fraction of non-renewable biomass, in percentage

$BB_{b1,bio}$ and $BB_{b1,fuel}$ are estimated *ex-ante* through the Kitchen Performance Test (KPT) survey conducted in December 2015. The Baseline KPT was performed by JRI Research, the consultant that is also in charge of carrying out the annual BUS surveys and has previous experience with designing KPTs. The surveying team was composed of 16 surveyors and 5 field supervisors. Guidance by the Gold Standard and the Berkeley Air KPT questionnaires was used to conduct the survey in the field. A sample of 51 household non-biogas users was targeted for the fuel measurement campaigns that defined how much biomass and fossil fuel is used by the households for cooking purposes. 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. Weighting scales were calibrated, and surveyors were trained prior to implementing the measurement campaign in the field. All surveyed data were checked and processed by JRI Research, and then reported to head office in Jakarta (NBPSO).

Baseline emissions relating to the use of biomass and fossil fuel shall be fixed for the entire crediting period.

Determining $BB_{b1,bio}$
The majority of the respondents (65%) indicated firewood to be their primary fuel source for cooking purposes. The total average firewood use per household of the overall sample population amounted to 3.45 kg per day, or 1.259 tonnes per year.[20]

Determining $BB_{b1,fuel}$
Three-quarters of the visited households also reported LPG to be a fuel source for cooking purposes. These households reported an average monthly use of 12.7 kg of LPG, equivalent to 152 kg of LPG per year. For 33% of these, LPG was mentioned as the most popular fuel source. The total average LPG use per household of the overall sample population amounted to 0.32 kg per day, or 117 tonnes per year.[21] No kerosene use was reported in the Baseline KPT.

Determining EF and NCV

[20] Calculated as (3.45 * 365)

[21] Calculated as (0.32 * 365)

Reference is made to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for the default EF_{fuel}, EF_{bio}, NCV_{fuel}, NCV_{bio} values. The values are listed in Section B.5.1.

Determining f_{NRB}

FAO[22] reports that Indonesia's primary forest cover equates to 47,236,000 ha. Besides this natural forest, 3,549,000 ha[23] to 4,841,000 ha[24] are covered by plantations, either under public or private ownership. Since pressure on primary forests is to be minimised and forest plantations are in place to provide the supply of sustainable timber for firewood and industrial roundwood removal, Demonstrably Renewable Biomass (DRB) is the amount of biomass that can be sustainably harvested from these plantations.

The International Tropical Timber Organisation (ITTO) reports that the average sustainable yield of the plantations in Indonesia is between 4 and 13 m^3 per ha, depending on the wood species. Applying a 10 m^3 for conservativeness, the annual sustainable yield from the plantations is determined to be 35,490,000 m^3 which corresponds to 35,378,000 m^3 estimated by ITTO (2009)[25]. The more conservative number 35,490,000 m^3 is applied in this calculation and is multiplied by the fraction of wood fuel removals from total timber removals (85.57 %) reported by the FAO, which yields a DRB of 30,411,351 m^3.

To determine the fraction of NRB, the following formula is applied[26]:

$$\boldsymbol{f_{NRB,y}} = \frac{NRB}{NRB+DRB} \quad (4)$$

B_y is the amount of fuel wood removed from forests which amounts to 86,396,000 m^3, as reported by FAO.[27] NRB can be calculated by subtracting the DRB of 30,411,351 m^3 from B_y of 86,396,000 m^3.

Therefore, the fraction of NRB is as follows:

$$\boldsymbol{f_{NRB,y}} = \frac{55{,}984{,}649}{86{,}396{,}000} = \mathbf{64.8}\ \%$$

Calculation

The baseline emissions of the non-renewable biomass and fossil fuel per household per year under the VPA-2 are:

$$\mathbf{BE_{b1,CO2,y}} = 1 * (0.117 * 63.1 * 0.0473) + (0.000 * 71.9 * 0.0441) + (1.259 * 112 * 0.015 * 64.80\%) = \mathbf{1.720\ tCO_2e}$$

Therefore:

$$\mathbf{BE_{b1,CO2,y}} = (0.349) + (0.000) + (1.370) = \mathbf{1.720\ tCO_2e}$$

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:

[22] FAO (2010) 'Global Forest Resources Assessment 2010 Country Report Indonesia'

[23] FAO (2010) 'Global Forest Resources Assessment 2010 Country Report Indonesia'

[24] ITTO (2009) Encouraging Industrial Forest Plantations in the Tropics

[25] ITTO (2009) Encouraging Industrial Forest Plantations in the Tropics

[26] AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user (Version 04)

[27] FAO (2010) 'Global Forest Resources Assessment 2010 Country Report Indonesia'

$$PE_{p1,CO2,y} = \sum(BB_{p1,fuel} * NCV_{fuel} * EF_{p1,fuel}) + (BB_{p1,bio} * NCV_{bio} * EF_{p1,bio} * f_{NRB}) \quad \textbf{(5)}$$

Where:

$PE_{p1,CO2,y}$	Cumulative project CO_2 emissions from the use non-renewable biomass and fossil fuels at households during year y
$BB_{p1,fuel}$	The quantity of fossil fuel consumed in the project scenario 1, in tonnes/year
NCV_{fuel}	Net calorific value of fossil fuel, in TJ/tonne
$EF_{p1,fuel}$	CO_2 emission factor of fossil fuel in project scenario 1, in tonnes/TJ
$BB_{p1,bio}$	The quantity of biomass consumed in the project scenario 1, in tonnes/year
NCV_{bio}	Net calorific value of biomass, in TJ/tonne
$EF_{p1,bio}$	CO_2 emission factor of biomass in project scenario 1in tonnes/TJ
f_{NRB}	Fraction of non-renewable biomass, in percentage

Ex-ante $BB_{p1,fuel}$ and $BB_{p1,bio}$, the quantities of fossil fuel and biomass consumed during year y, are established using the Project KPT conducted in December 2015.

Determining $BB_{p1,bio}$
Just over one-third of the surveyed households indicated firewood to be still in use after the implementation of the biodigester. The total average firewood use per household of the overall sample population amounted to 1.18 kg per day, or 432 tonnes per year.[28]

Determining $BB_{p1,fuel}$
Another one-third of the surveyed households indicated LPG to be still in use after the implementation of the biodigester. The total average LPG use per household of the overall sample population amounted to 0.08 kg per day, or 29 tonnes per year.[29] No kerosene use was reported in the Project KPT.

Reference is made to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for the default EF_{fuel}, EF_{bio}, NCV_{fuel}, NCV_{bio} values. The values are listed in Section B.5.1.

Prior to submission for verification, the values presented in the equation below shall be updated *ex-post* through the data collected during the Baseline and Project Performance Tests. New tests need to be conducted every second year. The tests will target end users representative of the baseline and project scenario target population and shall be arranged in accordance with the guidance provided by the methodology[30].

The project emissions of the non-renewable biomass and fossil fuel per households per year under the VPA-2 are:

$$\mathbf{PE_{p1,CO2,y}} = 1 * \big((0.029 * 63.1 * 0.0473) + (0.000 * 71.9 * 0.0441) + (0.432 * 112 * 0.015 * 64.80\%)\big) = \mathbf{0.557\ tCO_2e}$$

Therefore:

$$\mathbf{PE_{p1,CO2,y}} = (0.087) + (0.000) + (0.432) = \mathbf{0.557\ tCO_2e}$$

[28] Calculated as (1.18 * 365)

[29] Calculated as (0.08 * 365)

[30] 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011) p.12 - 14

Leakage:
In accordance with the methodology, the following potential sources of leakage are to be considered:

- The displaced baseline cook stoves- 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 non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources;
- 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;
- 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;
- By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within users who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

A leakage investigation shall be conducted every two years using relevant survey methods that can be combined with monitoring surveys as is applicable. Leakage risks deemed very low will be ignored where the case for their insignificance can be substantiated.

Leakage per household per year shall be calculated as a quantitative emissions volume (tCO_2e) or as a percentage of total emission reductions.

$$LE_{p1,CO2,y} = \left(BE_{b1,CO2,y} - PE_{p1,CO2,y}\right)*(x\%) \quad \textbf{(6)}$$

Leakage is assumed to be 5% for the ex-ante project emissions. This parameter will be monitored, as per the monitoring plan, and the actual figure will be used to calculate total project emissions. The leakage of the non-renewable biomass and fossil fuel used by households under the VPA-2 are:

$$LE_{p1,CO2,y} = (1.72 - 0.557)*(5\%) = 0.058\ tCO_2e$$

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

$$ER_{CO2,y} = \left(BE_{b1,CO2,y} - PE_{p1,CO2,y} - LE_{p1,CO2,y}\right)* N_{p1,y}* U_{p1,y} \quad \textbf{(7)}$$

Where:

$ER_{CO2,y}$	Emission reductions in year y (tCO_2)
$BE_{b1,CO2,y}$	Baseline emissions during the year y (tCO_2)
$PE_{p1,CO2,y}$	Project emissions during the year y (tCO_2)
$LE_{p1,CO2,y}$	Leakage during the year y (tCO_2)
$N_{p1,y}$	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y
$U_{p1,y}$	Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

Calculation
The emission reductions per household per year due to the displacement of non-renewable biomass and fossil fuels under the VPA-2 are:

$$1.720 - 0.557 - 0.058 = \mathbf{1.104\ tCO_2e}$$

Total emission reductions per VPA per year (once the total amount of forecasted 20,000 units are in place) are:

$$\mathbf{ER_{CO2,y}} = (1.720 - 0.557 - 0.058) * 20{,}000 * 1 = \mathbf{22{,}085\ tCO_2e}$$

ii. Accounting for emission reductions due to the avoidance of methane emissions from manure handling.

The baseline emissions from the handling of animal waste for VPA-2 are determined using the IPCC Tier 1 approach.

Baseline emissions following Tier 1:
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. This formula calculates the baseline emissions per household:

$$\mathbf{BE_{b1,CH4,y}} = GWP_{CH4} * \sum_T (EF_{awms,T} * N_{T,h}) \quad \textbf{(8)}$$

Where:

$BE_{b1,CH4,y}$	Baseline emissions from manure handling during the year y in tCO_2e
GWP_{CH4}	Global Warming Potential of methane (25)
$EF_{awms,T}$	Emission factor for the defined livestock population category T
$N_{T,h}$	Number of livestock category T in premise h

Determining $EF_{awms,T}$
The relevant default methane emission factor ($EF_{awms,T}$) for Asian livestock is sourced from Tables 10.14 – 10.16 of the IPCC Guidelines for National Greenhouse Gas Inventories.[31] These values are reported in Section B.5.1. A national average temperature of 27.1°C applies, as reported by the Indonesian Meteorological Climatological and Geophysical Agency.[32]

Determining $N_{T,h}$
The KPT implemented in December 2015 asked respondents to indicate the amount and types of livestock kept. The only reported type of cattle owned by the respondents was dairy cows. The average number of animals kept was 4.47 dairy cows. About half of the households raised a second animal type, predominantly poultry. For conservativeness, methane emissions from poultry are not included in the baseline calculation.

Calculation
The baseline methane emissions per household per year under the VPA-2 are:

[31] IPCC Guidelines for National Greenhouse Gas Inventories (2006) 'Chapter 10: Emissions from Livestock and Manure Management'

[32] http://www.bmkg.go.id

$$\mathbf{BE_{b1,CH4,y}} = 25 * \left((100\% * 4.47 * 0.031)\right) = \mathbf{3.464\ tCO_2e}$$

Project emissions following Tier 1:

Project emissions include both the physical leakage of biogas from the biodigester and the incomplete combustion of biogas. These shall be accounted for in accordance with equation (17) of the applicable methodology. This formula calculates the project emissions per household:

$$\mathbf{PE_{p1,CH4,y}} = \mathrm{GWP_{CH4}} * \sum(\mathrm{N_{T,h,y}} * \mathrm{EF_{awms,T}}) * \mathrm{PL_y} + \sum(\mathrm{N_{T,h,y}} * \mathrm{EF_{awms,T}}) * (1 - \eta_{new\ stove})(1 - \mathrm{PL_y}) + \mathrm{PE_{awms,NT}} \quad (\mathbf{9})$$

Where:

$PE_{p1,CH4,y}$	Project emissions from manure handling during the year y in tCO_2e
GWP_{CH4}	Global Warming Potential of methane (25)
$N_{T,h}$	Number of livestock category T in premise h
$EF_{awms,\ T}$	Emission factor for the defined livestock population category T
PL_y	Physical leakage of the biodigester (through measurement or application of 10% default)
$\eta_{\ new\ stove}$	Combustion efficiency of the used type of biogas stove
$PE_{awms,NT}$	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.

Calculation

The project methane emissions per household per year under the VPA-2 are:

$$\mathbf{PE_{p1,CH4,y}} = 25 * \left(\left(\left((100\% * 4.47 * 0.031)\right) * 10\%\right) + \left(\left((100\% * 4.47 * 0.031)\right) * (1 - 50\%) * (1 - 10\%)\right) + 0\right) = \mathbf{1.905\ tCO_2e}$$

Total emissions reductions following Tier 1:

Emission reductions per VPA will be calculated as:

$$\mathbf{ER_{CH4,y}} = \left(\mathrm{BE_{b1,CH4,y}} - \mathrm{PE_{p1,CH4,y}}\right) * \mathrm{N_{p1,y}} * \mathrm{U_{p1,y}} \quad (\mathbf{10})$$

Where:

$ER_{CH4,y}$	Methane emissions reductions in year y (tCO_2)
$BE_{b1,CH4,y}$	Baseline methane emissions during the year y (tCO_2)
$PE_{p1,CH4,y}$	Project methane emissions during the year y (tCO_2)
$N_{p1,y}$	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y

U_{p1y} Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop off rate (fraction)

Calculation
The emission reductions from methane avoidance per household per year under the VPA-2 are:

$$3.464 - 1.905 = \mathbf{1.496\ tCO_2e}$$

Total emission reductions per VPA per year (once the total amount of forecasted 20,000 units are in place) are:

$$\mathbf{ER_{CH4,y}} = (3.464 - 1.905) * 20{,}000 * 1 = \mathbf{31{,}178\ tCO_2e}$$

The table below indicates the summary of the ex-ante estimation of emission reductions per household:

Scenario	BE (tCO_2e)	PE (tCO_2e)	LE (tCO_2e)	**ER**(tCO_2e)
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 total emission reductions of the VPA per year (once the total amount of forecasted 20,000 units are in place) from both the displacement of fossil fuels and non-renewable biomass and avoidance of methane emissions from manure handling are:

$$\mathbf{ER_{Total}} = 22{,}085 + 31{,}178 = \mathbf{53{,}263\ tCO_2e}$$

D.6.4. Summary of the ex-ante estimates of emission reductions

Year	Baseline emissions (t CO_2e)	Project emissions (t CO_2e)	Leakage (t CO_2e)	Emission reductions (t CO_2e)
01/01/2017 – 31/12/2017	7,128	3,386	80	3,662
01/01/2018 – 31/12/2018	22,680	10,774	254	11,651
01/01/2019 – 31/12/2019	39,419	18,726	442	20,251
01/01/2020 – 31/12/2020	57,563	27,346	645	29,572
01/01/2021 – 31/12/2021	75,707	35,965	849	38,893
01/01/2022 – 31/12/2022	93,851	44,584	1,052	48,214
01/01/2023 – 31/12/2023	103,679	49,253	1,162	53,263
Total	**400,027**	**190,034**	**4,485**	**205,508**
Total number of crediting years	7			
Annual average over the crediting period	57,147	27,148	641	29,358

D.7. Application of the monitoring methodology and description of the monitoring plan

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D.7.1. Data and parameters to be monitored

Data / Parameter	$U_{p1,y}$
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)
Source of data	Collected through the annual Biogas User Survey.
Value(s) applied	1
Measurement methods and procedures	
Monitoring frequency	Annual
QA/QC procedures	The usage rate of thermal applications will be 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 comment	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	$N_{p1,y}$
Unit	Number
Description	Cumulative project operational rate included in the project database for project scenario p1 against baseline scenario b1 in year y
Source of data	IDBP database.
Value(s) applied	Reported as a result of ($No_{p1,y}$ * ($O_{p1,y}$ / 365)), which equals (20,000 * 365/365) = 20,000
Measurement methods and procedures	
Monitoring frequency	Continuous
QA/QC procedures	As per procedures of the IDBP database.
Purpose of data	To account for non-operational units in the emission reduction calculation
Additional comment	$N_{p1,y}$ shall be calculated from (a) the number of installed system (parameter $No_{p1,y}$); and (b) the average operational days of the system ($O_{p1,y}$). The equation is therefore ($N_{p,y}$ = $No_{p,y}$ * ($O_{p,y}$ / 365))The average operational days will be confirmed upon verification. Households are required to notify provincial office staff in a situation when a biodigester stops working. This information is recorded in the IDBP database, allowing the identification per included biodigester the amount of operational days per year. In a scenario where the biodigester stops operating, the number of non-operational days is recorded in the database.

Data / Parameter	$No_{p1,y}$
Unit	Number
Description	Cumulative number of project technologies included in the project database for project scenario p in year y
Source of data	IDBP database.
Value(s) applied	20,000
Measurement methods and procedures	
Monitoring frequency	Continuous
QA/QC procedures	As per procedures of the IDBP database.
Purpose of data	
Additional comment	The actual cumulative number of biodigester operational days will be confirmed upon verification.

Data / Parameter	$O_{p1,y}$
Unit	Number
Description	The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y
Source of data	IDBP database.
Value(s) applied	365
Measurement methods and procedures	
Monitoring frequency	Continuous
QA/QC procedures	As per procedures of the IDBP database.
Purpose of data	
Additional comment	The actual cumulative number of biodigester non-operational days will be confirmed upon verification. The equation to calculate this is ($O_{p,y}$ = 365 – non-operational days)

Data / Parameter	$LE_{p1,y}$
Unit	tCO_2e/year
Description	Leakage in project scenario p during year y
Source of data	Collected through the annual Biogas User Survey.
Value(s) applied	5%
Measurement methods and procedures	
Monitoring frequency	Every two years

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 comment	-

Data / Parameter	**$N_{T,h}$**
Unit	Number
Description	Number of animals of livestock category T in premise h
Source of data	Baseline KPT, December 2015
Value(s) applied	Dairy cow = 4.47 Buffalo = 0.00
Measurement methods and procedures	
Monitoring frequency	Annual
QA/QC procedures	*Ex-post* value to be derived from the Biogas User Survey
Purpose of data	
Additional comment	

Data / Parameter	**PL**
Unit	%
Description	Physical leakage of the biodigester
Source of data	IPCC
Value(s) applied	Estimated using a 10% default rate of total methane production
Measurement methods and procedures	
Monitoring frequency	Annual
QA/QC procedures	-
Purpose of data	
Additional comment	As per Annex 6 of the applied methodology

Data / Parameter	**$BB_{b1,bio}$**
Unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario 1: households
Source of data	Baseline KPT, December 2015
Value(s) applied	1.259
Measurement methods and procedures	

Monitoring frequency	Updated every two years through the Baseline Performance Field Test
QA/QC procedures	*Ex-post* value to be determined through the Baseline Performance Field Test
Purpose of data	
Additional comment	

Data / Parameter	$BB_{b1,fuel}$
Unit	Tonnes/year
Description	Amount of fossil fuels used in the baseline scenario 1: households
Source of data	Baseline KPT, December 2015
Value(s) applied	LPG = 0.117 Kerosene = 0.000
Measurement methods and procedures	
Monitoring frequency	Updated every two years through the Baseline Performance Field Test
QA/QC procedures	The following conversion factor for kerosene is applied: 1 liter = 0.82 kg[33] *Ex-post* value to be determined through the Baseline Performance Field Test.
Purpose of data	
Additional comment	

Data / Parameter	$BB_{p1,fuel}$
Unit	Tonnes
Description	Quantity of fossil fuel consumed in project scenario 1 during year y, in tonnes
Source of data	Baseline KPT, December 2015
Value(s) applied	LPG: 0.029 Kerosene: 0.000
Measurement methods and procedures	
Monitoring frequency	Updated every two years through the Project Performance Field Test
QA/QC procedures	Shall be in line with Section 7 of the applied methodology.
Purpose of data	
Additional comment	

Data / Parameter	$BB_{p1,bio}$

[33] Lawrence Berkeley National Laboratory (2003) 'Technical and Economic Performance Analysis of Kerosene Lamps and Alternative Approaches to Illumination in Developing Countries'

Unit	Tonnes
Description	Quantity of biomass consumed in project scenario p during year y, in tonnes
Source of data	Baseline KPT, December 2015
Value(s) applied	0.432
Measurement methods and procedures	
Monitoring frequency	Updated every two years through the Project Performance Field Test
QA/QC procedures	Shall be in line with Section 7 of the applied methodology.
Purpose of data	
Additional comment	

Data / Parameter	**$MS_{P,S,K}$**
Unit	%
Description	Fraction of livestock category T's manure not treated in bio-digester, in climate region k
Source of data	Collected through the Biogas User Survey.
Value(s) applied	0
Measurement methods and procedures	Survey
Monitoring frequency	Annual
QA/QC procedures	-
Purpose of data	
Additional comment	-

Data / Parameter	**$MS_{T,S,k}$**
Unit	%
Description	Fraction of livestock category T's manure fed into the bio-digester, S in climate region k
Source of data	Collected through the Biogas User Survey.
Value(s) applied	100%
Measurement methods and procedures	Survey
Monitoring frequency	Annual
QA/QC procedures	
Purpose of data	
Additional comment	Applicable to VPAs applying Tier 2 only

Data / Parameter	GWP_{CH4}
Unit	-
Description	Global Warming Potential of methane
Source of data	IPCC (2006); May be updated according to any future changes by the IPCC
Value(s) applied	25
Measurement methods and procedures	IPCC default
Monitoring frequency	Annual
QA/QC procedures	
Purpose of data	-
Additional comment	May be updated according to any future changes by the IPCC

Data / Parameter	Bio
Unit	0
Description	Use of bio-slurry
Source of data	Biogas User Survey
Value(s) applied	-
Measurement methods and procedures	
Monitoring frequency	Annual
QA/QC procedures	
Purpose of data	-
Additional comment	To be used for the calculation of project emissions associated with bio-slurry usage – the CH_4 emissions from the anaerobic decay of the residual organic content of digestate subjected to anaerobic storage.

The VPA-2 will also monitor the following social and environmental parameters, as defined under the Gold Standard[34]:

Data / Parameter	GS-03 Soil condition
Unit	Number
Description	Soil condition refers to changes compared to the baseline in organic matter content.
Source of data	Collected through the annual Biogas User Survey.
Measurement methods and procedures	Number of users applying the final biodigester slurry on agricultural land. Data is to be collected annually.

[34] Refer to accompanying Gold Standard PoA-Passport for further details

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).
Additional comment	-

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.
Source of data	Collected through the IDBP Database.
Measurement methods and procedures	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.
Additional comment	-

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.
Source of data	Collected through the annual Biogas User Survey.
Measurement methods and procedures	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).
Additional comment	-

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 number of biogas units commissioned.
Source of data	Collected through the IDBP Database.

Measurement methods and procedures	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).
Additional comment	-

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.
Source of data	Through the IDBP Database; Biogas User Survey
Measurement methods and procedures	Either confirmed through the IDBP Database or carried out as part of the annual Biogas User Survey conducted by the IDBP.
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).
Additional comment	-

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 amount of users selling biodigester slurry on the market will be monitored.
Source of data	Employment records and through the IDBP Database; Biogas User Survey.
Measurement methods and procedures	A record will be kept of all employees and jobs created as part of the programme. Hard copies of employment contracts will be kept by the CME, and details recorded in the centralised record-keeping database managed by the CME. Through the Biogas User Survey, the amount 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).
Additional comment	-

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.
Source of data	Training records and through the IDBP Database; Biogas User Survey.
Measurement methods and procedures	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).
Additional comment	-

D.7.2. Description of the monitoring plan

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All monitoring is coordinated by Hivos, the implementer of VPA-2 and the CME of the programme. The sampling plan of this VPA is in line with EB65 annex 2 Appendix 3 is outlined below.

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), as detailed in D.7.1 above. In accordance with the requirements set forth in the methodology, the sample size will be selected following a 90% confidence interval and a 10% margin of error (90/10), where applicable.

Multi-stage sampling[35] 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 $12m^3$) and medium-scale digesters (defined as capacities larger than $12m^3$).

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" (Version 3.0). 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

[35] As defined by the General Guidelines for Sampling and Surveys for Small-Scale CDM project activities, EB 50 Annex 30

of monitoring procedure (households, local communities, and SMEs with installed biodigesters), as identified through the centralised record-keeping database managed by the CME.

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[36]. 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[37], 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 JRI Research, 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

[36] Technologies and Practices to Displace Decentralized Thermal Energy Consumption (11/04/2011), p.24

[37] 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.

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 bioslurry shall be monitored according the applied methodology. If there is any anaerobic use/storage of bioslurry 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.

SECTION E. Approval and authorization

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This section is not applicable as the project is a Voluntary Gold Standard Programme.

Appendix 1. Contact information of VPA implementer(s) and responsible person(s)/ entity(ies) for completing the CDM-VPA-DD-FORM

VPA implementer and/or responsible person/ entity	☒ VPA implementer(s) ☐ Responsible person/ entity for completing the CDM-VPA-DD-FORM
Organization	Hivos Indonesia
Street/P.O. Box	Jl. Kemang Selatan XII/no.1
Building	
City	Jakarta
State/Region	
Postcode	12560
Country	Indonesia
Telephone	+62-21 78837577 / 7808115
Fax	+62-21 7808115
E-mail	r.degroot@hivos.or.id
Website	www.hivos.nl
Contact person	
Title	Mr.
Salutation	
Last name	de Groot
Middle name	
First name	Robert
Department	Regional Office Southeast Asia
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

VPA implementer and/or responsible person/ entity	☐ VPA implementer(s) ☒ Responsible person/ entity for completing the CDM-VPA-DD-FORM
Organization	Climate Focus B.V.
Street/P.O. Box	Sarphatikade 13
Building	
City	Amsterdam
State/Region	
Postcode	1017 WV
Country	The Netherlands
Telephone	+31 20 262 1038
Fax	
E-mail	info@climatefocus.com
Website	www.climatefocus.com
Contact person	

Title	Mr.
Salutation	
Last name	Mikolajczyk
Middle name	
First name	Szymon
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

geen grenzen aan mensen

Hivos

Date: 17 January 2012
Project reference: Gold Standard PoA Indonesia Domestic Biogas
To: Gold Standard Foundation

Declaration of Non-Use of Official Development Assistance by Project Owner

Humanist Institute for Co-operation with Developing Countries, Hivos
As Project Owner of the above-referenced project, acting on behalf of all project participants, I now make the following representations:

Ben Witjes, Director Programmes & Projects

I hereby declare that I am duly and fully authorised by the project owner of the above referenced project, acting on behalf of all project participants, to make the following representations on Project Proponent's behalf:

I. Gold Standard Documentation
I am familiar with the provisions of Gold Standard Documentation relevant to Official Development Assistance (ODA). I understand that the above-referenced project is not eligible for Gold Standard registration if the project receives or benefits from Official Development Assistance under the condition that some or all credits coming out of the project are transferred to the ODA donor country. I now expressly declare that no financing provided in connection with the above-referenced project has come from or will come from ODA that has been or will be provided under the condition, whether express or implied, that any or all of the credits [CERs, ERUs or VERs] issued as a result of the project's operation will be transferred directly or indirectly to the country of origin of the ODA.

II. Duty to Notify Upon Discovery.
If I learn or if I am given any reason to believe at any stage of project design or implementation that ODA has been used to support the development or implementation of the project, or that an entity providing ODA to the host country may at some point in the future benefit directly or indirectly from the credits generated from the project as a condition of investment, I will make this known to the Gold Standard immediately.

III. Sanctions. I am fully aware that under Section 10 of the Gold Standard Terms and Conditions sanctions and damages may be incurred for the provision of false information related to Projects and/or Gold Standard credits.

Signed:

Name: R.g.M. Wijkes

Title: Director Programmes & Projects

On behalf of: Hivos

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Appendix 3. Applicability of methodology(ies) and standardized baseline(s)

This section is not applicable as the project is a Voluntary Gold Standard Programme.

Appendix 4. Further background information on ex ante calculation of emission reductions

This section is not applicable as the project is a Voluntary Gold Standard Programme.

Appendix 5. Further background information on monitoring plan

This Section includes Section A.4.4.1 of the PoA-DD, which outlines the VPA's operational and management plan. This plan lays out the framework to ensure that programme execution and operation achieves real and measurable emission reductions and supports the verification process. The entities involved in the PoA and their tasks are defined below.

i. Entities involved in the programme.

The CME (Hivos): Responsible for overall programme execution and management, raising awareness, promotion, capacity building, quality control, extension services, general monitoring and reporting. It will liaise with financial institutions to determine terms and conditions for loans to programme participants, and management of subsidies. It will also be responsible for investing the carbon revenues in the project to enhance the dissemination of biodigesters. It will fulfil the following tasks:[38]

- General management of the programme, including its carbon asset management and coordination of the contributions of all entities involved;
- Draft monitoring reports for all VPAs in accordance with the methodology version applied in time of inclusion of the VPA of the methodology 'Technologies and practices to displace decentralized thermal energy consumption' (11/04/2011) outlined in the registered PoA-DD;
- Coordinate and communicate with the validator/verifier and the Gold Standard Foundation;
- Maintain a system for management and record keeping for each VPA under the PoA;
- Coordinate quality control check of the technology implemented;
- Prepare monitoring reports for carbon credit verification and issuance;
- Request the Gold Standard Foundation to issue carbon credits into a registry account.

Users: End-users will purchase the biodigester, treat animal waste with it, reduce NRB and/or fossil fuel use, and ensure effective destruction of methane through appropriate biogas use. Furthermore they can use or sell bio-fertiliser produced as a by-product of the digestion process. They will support monitoring efforts required by the programme and will transfer the title to the generated emission reductions to the CME. There are three distinct groups of users targeted under this PoA:

1) Households: Individual houses inhabited by dairy farmers or other types of farmers.
2) Communities: Aggregation of individuals living or meeting in a particular place or area, such as schools, farmer communities, or other social venues.
3) SMEs: Domestic firms with an annual turnover of up to 300 million Rupiah, as defined by the Indonesian Law of Micro, Small and Medium Enterprises from 2008.[39]

Technology Suppliers: Suppliers are responsible for providing reliable biogas technologies and providing/arranging after-sale services for users. In doing so, they will prepare Household Agreements and Completion Reports and arrange for after-sales service for users and assist in PoA monitoring at the request of Hivos.

VPA implementing entity: The VPA implementing entity is the party that is in charge for realising a particular VPA. While this role can be performed by the CME, other parties can join the programme and set up new VPAs.

(Micro) finance institutions ((M)FIs): (M)FIs involved in this PoA will act as loan provider.

ii. Operational and management plan of the programme.

The operation of the programme, including the installation and commissioning of the biodigesters will be carried out as per the procedure outlined below.

[38] CDM Executive Board guide: EB 32, Annex 38

[39] Indonesian Law No.20 on Micro, Small and Medium Enterprises (2008)

Figure 1 – General operational framework & responsibilities

1. Pre-construction Form: The pre-construction phase is a time where the CPO surveys the potential household and establishes the eligibility of the household to become a biodigester user. The gathered information is included in the Pre-construction Form. The information in the form is used to ensure that the household receives the appropriate size of biodigester given the household size and the amount of farm animals kept. After the form is filled in, the CPO will submit the form to IDBP for approval.

2. Household Agreement: Supplier and user in each VPA shall sign a 'Household Agreement', which is the sales contract covering the biodigester. The supplier is responsible for ensuring that the information is correct and complete. The Household Agreement will, at least, contain the following data, in addition to specific sales and financing arrangements:
   - A unique serial number of the implemented biodigester. The serial number shall either be physically attached to or integrated in the biogas system or recorded in the User's Manual.
   - Date of installation (day when construction of the biodigester begins);
   - Name of the user;
   - Address of the user;
   - Mobile phone number/landline of the user (if available);
   - Type and size (m3) of the biodigester;
   - Typology of the user: household, community and SMEs;
   - Acknowledgement that the user is aware that the installation is operating as part of a PoA, and confirmation that they are not taking part in another registered PoA;
   - Confirmation from the user that his participation in the PoA is voluntary;

- A confirmation that the user assigns the right and title to the generated emission reductions to Hivos;
- Signature of the user;
- Name, company, contact details and signature of the supplier.

3. Installation: Supplier will install the biodigester, or have a specialised installation company do so. The installation is finalised by filling and inoculating the biodigester.

4. Commissioning: One week after installation, the supplier shall commission the biodigester by:
   - Handing over the biogas appliances;
   - Checking sufficient flow of gas;
   - Instructing the user to contact the supplier should any maintenance be needed. Contact details of the supplier shall be provided;
   - Instructing the user to contact the supplier should the biodigesters be removed;
   - Providing user training on the proper application of slurry to agricultural land;
   - Providing user training on how to record the quantity of manure fed into the biodigesters;
   - Providing user training on the operation and maintenance of the biogas system, and, if applicable, the water collection facility;
   - Filling out the 'Completion Report' , which will contain the following data:
     - A unique serial number of the implemented biogas system. The serial number shall either be physically attached to or integrated in the biogas system or recorded in the User's Manual.
     - Date of completion, which will be equal to the start date of emission reduction generation;
     - Confirmation that the user has been given training on the proper application of slurry to soils and how to record the quantity of manure fed into the biodigester, confirmation that the user assigns the right and title to the generated emission reductions to the CME, confirmation of the acknowledgement that the user is aware that engagement in the programme is voluntary; and confirmation of the acknowledgement that the user is aware that the installation is operating as part of the programme.
     - Name and signature of user;
     - Name and signature of commissioner.

It will be the responsibility of the supplier to ensure that data recorded in the 'Completion Report' is correct and complete.

1. Data entry: The supplier shall provide hard copies of the 'Household Agreement and the Completion Report to the CME, who will be responsible for entering data 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.

2. Operation of biodigester: The end-user will have been provided with the contact details of the supplier should the system need maintenance at any time during the project. It will be the user's responsibility to use the biogas system as instructed during commissioning.

3. Monitoring report: The CME will be responsible for the production of periodical monitoring reports, which will be verified by the DOE.

4. Verification: The DOE will verify monitoring reports and can perform a site visit of each VPA included in the PoA.

iii. A record keeping system for each VPA under the PoA.

The CME shall have a procedure for technical review of inclusion of VPAs to ensure that each VPA meets all requirements and eligibility criteria before its inclusion in the registered PoA. The Senior Technical Advisor at IDBP will be responsible for the technical review of inclusion of VPAs. The CME shall assign dedicated staff for the management of the record keeping system, and as such it will manage and maintain a digital database with all biogas systems in the PoA, with a clear division between the different VPAs. For each biodigester installed, the CME shall also keep a paper copy of the 'Household Agreement and the 'Completion Report that is provided by the suppliers.

The staff responsible for sales and commissioning shall ensure the accuracy of the dates in both documents. Hard copies of both documents will be kept at the office of the CME, and all dates entered into the IDBP database.

The record keeping database will be used to record the results of all monitoring, thereby avoiding double counting, with all data stored to be kept for at least two years after the crediting period or the last issuance of carbon credits for the project activity. The database shall be updated annually and covers the following data:

- Records of arrangements for training and capacity development for, as proven through issuance of a certificate to all constructors – annually;
- The number of jobs generated through the IDBP – annually;
- Sales records – annually.

iv. Procedure to avoid double counting.

Double counting will be avoided by keeping a record of the serial number of each biogas installation in a centralised digital database operated and maintained by the CME, clearly divided per VPA. The data included in the database is detailed above (see '3. Commissioning'). This data can be used by the CME and DOE to identify and locate each individual biodigester installed. The results of all monitoring will also be recorded in the electronic database.

The CME must annually check the systems through sampling to ensure that:

- The recorded address at which the biodigesters are installed is still correct;
- The biodigesters are still operational (as part of the monitoring procedure);
- Serial numbers are unique and correspond with the numbers on the installed systems.

This quality control procedure for carrying out this check will be performed in line with the Quality Control Manual. If systems are no longer in operation the system will be listed as no longer functional and the reason recorded in the database. Also, if certain biodigesters are not used, only the used biodigesters will be taken into account when defining the emission reductions. If the address is found to no longer comply with the database and the user is found to be different to that listed in the 'Household Agreement, the new user will be asked to sign and complete the Household Agreement and, if willing to do so, will undergo commissioning. All new details will be recorded in the database. Where the new user does not wish to sign such contract or does not fit the criteria outlined, the system will be listed as no longer operational in the database and no emission reductions from that system will be accounted for.

There are two situations in which the address or serial number of the biodigester may change:

- A biodigester is replaced. The user will contact the supplier, as indicated during commissioning, who will record the case of a biodigester that needs replacing, and will enter the new serial number into the database, or inform the CME that this needs to be done;
- A biodigester is moved to a different location. During commissioning, the user will have been directed to contact the supplier should a biodigester be moved. If the user is found to differ from that registered in the database the new address will be recorded in the database and a new Household Agreement and Completion Report completed.

A record of old data will be kept alongside a description of the circumstances under which changes were made.

v. The provisions to ensure that those implementing the VPA are aware of and have agreed that their activity is being subscribed to the PoA.

The contracts of all contracted entities will state the involvement of their activities as part of a PoA. All users will also acknowledge they are aware of this as part of the Household Agreement.

vi. Procedure to ensure quality control pertaining to technical requirements of the biodigester implemented in the PoA

The PoA will follow strict quality control procedures to ensure commissioned biodigesters meet the specific construction quality standards pursued under the IDBP. Both the constructors and their supervisors will be trained to apply the quality standards enforced by the programme. To further minimise the risk of commissioning of ineligible biodigesters, each province that participates in the PoA will have at least one well trained quality inspector who is responsible for checking the biodigesters a) during the construction phase and b) upon commissioning. The selection of the checked biodigesters will be based on a random sample basis. The sampling will be representative of constructor, plant size, and the cluster area. The quality standards enforced under the programme have to be fully met by each commissioned biodigester, otherwise the constructors are penalised and requested to repair the defaults.

vii. Measures for continuous improvements of the PoA management system

Reviewing and continually improving IDBP's operations
The management of the CME will be responsible for ensuring that there is continual improvement in IDBP's operations. The management of the CME will make his/her decisions based on feedback from the individual provincial offices, which will get feedback from the field staff. The management of the CME will be regular communication with the provincial offices and the provincial offices will also be in regular communication with the field staff.

Corrective measures will be taken depending on issues raised (e.g. software issues will be corrected by the software developer, operational procedures for the field staff will be modified adhoc, etc.).

The management of the CME is committed to identifying opportunities for improvement and supporting their implementation. In order to identify areas for improvement, besides regular feedback from the Province Offices and Field Staff, the following issues will be discussed during Programme Meetings which will be held twice a year:

- Any inefficiencies in operation and management (e.g. in recording data or transferring data to database);
- Opportunities to employ better methods;
- Control of planned and unplanned changes.

In addition to that, when special technical issues needed to be undertaken in regard to the carbon component, the issues will be discussed at Quality Inspection meetings which are also held twice a year. Any improvements in the management system shall be checked against the POA-DD and VPA-DDs to ensure there is no conflict.

Reviewing and continually improving the Gold Standard process
The Gold Standard expert will follow the latest developments in the Gold Standard and where necessary will provide advice on updating procedures to comply with new rules and regulations under the Gold Standard. The expert will also critically assess the monitoring and verification processes and will advise management on updating and improving process for the collection of data and reporting. Finally, the expert will be in charge of renewing crediting periods for VPAs and updating the baseline for the PoA where deemed necessary.

Appendix 6. Summary of post registration changes

This section is not applicable as the project is a Voluntary Gold Standard Programme.