Project design document form

(Version 10.1)

Complete this form in accordance with the instructions attached at the end of this form.

BASIC INFORMATION	
Title of the project activity	Biogas Support Program - Nepal (BSP-Nepal) Activity-1
Scale of the project activity	☐ Large-scale ☒ Small-scale
Version number of the PDD	10
Completion date of the PDD	14/03/2019
Project participants	Alternative Energy Promotion Centre (AEPC)
Host Party	Nepal
Applied methodologies and standardized baselines	AMS.I.E. (ver. 09) Switch from non-renewable biomass for thermal applications by the user
Sectoral scopes linked to the applied methodologies	Type I: Renewable Energy Projects
Estimated amount of annual average GHG emission reductions	35,607 tCO2 e

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

The Biogas Support Program - Nepal (BSP-Nepal)[1] Activity-1 implemented by the Alternative Energy Promotion Centre (AEPC) aims to promote biogas digesters (biogas units) to households in the rural areas of Nepal. The projects under the activities are distributed in different districts of Nepal which is given in table A.1 below. The project activity will reduce greenhouse gas (GHG) emissions by displacing conventionally used fuel sources for cooking, such as non-renewable woody biomass (firewood) and/or fossil fuels (kerosene and/or LPG). Although the proposed activity reduces CH_4 and N_2O emission reductions by introducing a proper disposal of animal waste and by producing a bio-slurry for replacing the consumption of chemical fertilizers, these emission reductions are excluded from the calculation of emission reductions, which is conservative .

The project activity is a sub-project of the BSP-Nepal umbrella biogas program that aimed to install a total of 200,000 biogas digesters all over Nepal. Since it is the first sub-activity of the umbrella biogas program, the sub-project is named BSP-Nepal Activity-1. The umbrella biogas program is the fourth phase of the Nepali government's biogas program at the national level. Under the first three phases, a total of 111,395 biogas units were installed all over Nepal.

Despite the government's past efforts to develop the biogas market with the support from international donors, namely the German Development Bank (KfW) and the Netherlands Development Agency (SNV), the investment in the biogas sector is a non-commercial activity and faces several barriers in Nepal. With the phasing out of international support for the sector, the umbrella program requires the support of CDM to sustain.

The key elements of the BSP-Nepal umbrella program's approach are:

- Financial support for end-users through micro finance institutions and cooperatives;
- Uniform technical design of biogas units;
- Thorough quality control and monitoring of the production, installation and after-sales services of the participating biogas companies;
- Continuous research & development efforts to optimize the design and operation of biogas digester units and to tailor units them to the needs of the end-users;
- Social marketing through outreach, awareness, and training programs;
- Implementation of a fertilizer extension program to maximize the benefits of bio-slurry, a by-product of the biogas;
- Support to institutions servicing various functions of the biogas sector such as financing, construction, maintenance, manufacturing, training, and marketing, and
- Installation of biogas units on a scale that demonstrates CDM application in the commercialization of the biogas sector.

As part of contributing to the overall goals of the umbrella program, the proposed project activity has installed a total of 9,692 small biogas digester units from November 1, 2003 to June 15, 2004 in a number of districts of Nepal as shown below in Table A.1. The biogas digesters are installed within the territory of Nepal.

[1] Biogas Support Program – Nepal (BSP-Nepal) refers to the project activities and Biogas Sector Partnership-Nepal (again BSP-Nepal) refers to the Implementing Agency that works under the coordination of Alternative Energy Promotion Centre (the project sponsor) and has the status of NGO

Table A.1: Distribution of Biogas Units[2]

Districts	Number of units	Districts	Number of units	Districts	Number of units
Arghakhachi	21	Kabrepalanchowk	190	Rasuwa	23
Baglung	11	Kailali	571	Rautahat	70
Baitadi	1	Kanchanpur	469	Rupandehi	279
Banke	148	Kapilbastu	220	Sankhuwasabha	31
Bara	124	Kaski	573	Saptari	8
Bardiya	264	Kathmandu	70	Sarlahi	181
Bhaktapur	60	Lalitpur	101	Sindhuli	200
Chitawan	575	Lamjung	249	Sindhupalchowk	29
Dadeldhura	10	Mahottari	45	Siraha	11
Dang	352	Makawanpur	596	Solukhumbu	10
Darchula	29	Morang	398	Sunsari	226
Dhading	54	Myagdi	26	Surkhet	81
Dhankuta	135	Nawalparasi	423	Syangja	273
Dhanusa	13	Nuwakot	103	Tanahu	694
Dolakha	112	Palpa	215	Taplejung	9
Doti	5	Panchthar	41	Terathum	3
Gorkha	171	Parbat	74	Udayapur	91
Gumi	74	Parsa	21	**Total**	**9692**
Ilam	107	Pyuthan	19		
Jhapa	707	Ramechhap	96		

A biogas plant produces biogas, thermal energy for cooking. The power equivalent of the installed biogas units ranges from 1.16 KW to 2.32 KW and the total installed equivalent generation capacity of the proposed project activity totals 14.73 MW. The estimated average annual emission reduction from the project activity during this crediting period is 35,607 tCO_2e

Contribution to Sustainable Development

At the local level, the BSP-Nepal program has multiple social benefits. A major household benefit is the reduction in time and energy spent by women and children in collecting firewood for cooking. The project will attach latrines to biogas units providing better sanitation to rural households. Potential employment will add more than 15,000 people-years for skilled people in the construction, maintenance, marketing, and financing of biogas units. The use of biogas means negligible smoke, hence better family health. Moreover, the residual biological slurry from the biogas units can be used as superior organic fertilizers to enhance agricultural yields.

At the national level, the umbrella program supports the Nepali Government's sustainable energy goals as laid out in 10th Five Year Plan to improve energy access for rural poor and to reduce rural poverty by providing high quality biogas units to poor households at an affordable price. Additionally, the project will support forest conservation goals by substituting the non-renewable biomass used as firewood, with biogas, the renewable source of energy.

Project Type

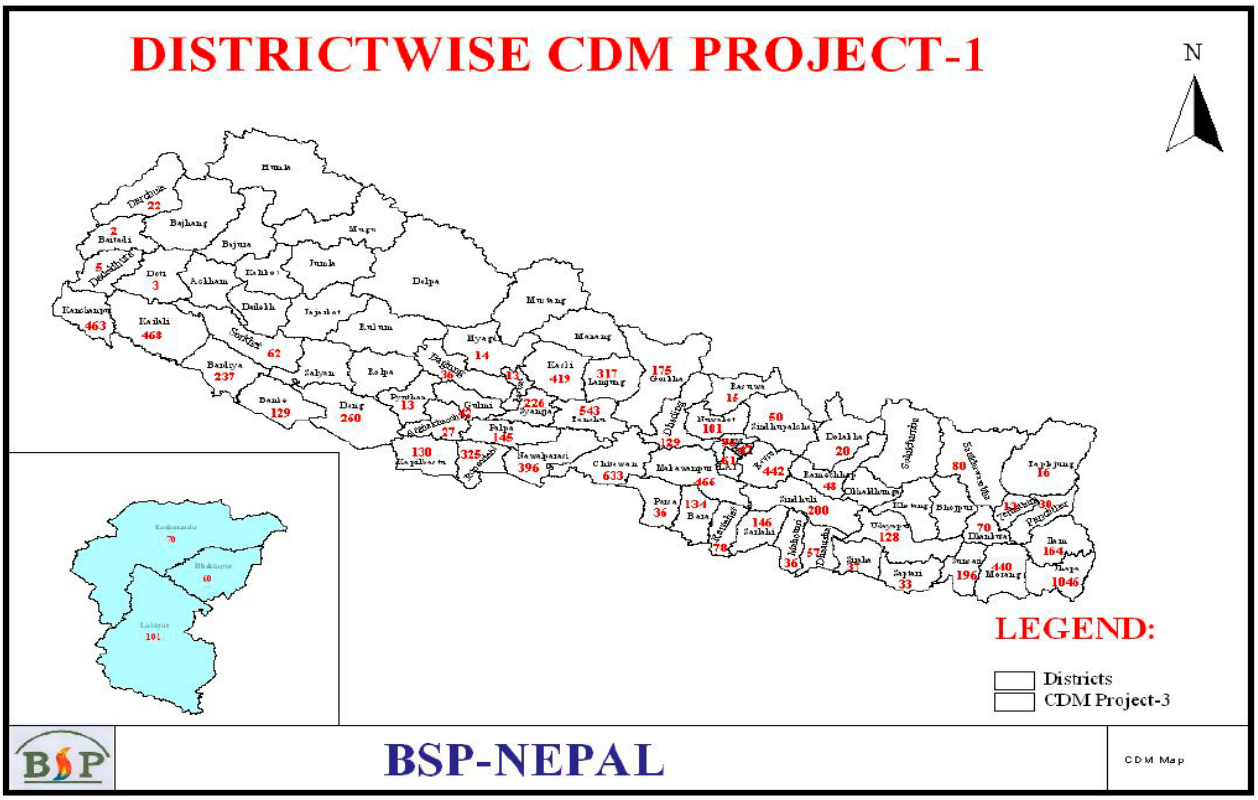
According to the project standard for the CDM project activity, the project activity belongs to Type I: Renewable Energy Projects as the maximum output from the project is below 45 $MW_{th.}$ There

[2] Out of the 9,708 plants installed originally and included in the project activity, 16 units of 6m3 size constructed in Makwanpur district (Hill region) have been reported during the monitoring (first crediting period) to be non-existing by the company in charge of installing and maintaining the units, as a landslide damaged and displaced the whole village. These 16 plants are not included in second crediting period for the emission reduction calculation. Thus, the total number of plants in the project activity has reduced to 9,692 from 9,708 during second crediting period.

are 9692 Biogas individual units under the project activities with the estimated capacity ranges from 1.16 KW to 2.32 KW, the individual bio-digester also qualifies for the Type-I Micro-scale project which meets the limit of micro-scale of 5 MW capacity.

A.2. Location of project activity

The project activity is located in the Federal Democratic Republic of Nepal. The biogas digesters are sold by pre-qualified companies and installed in the tarai, hill and mountainous regions of Nepal. The actual location of each digester is recorded in the digester database. The biogas units of the project activity have been installed in 57 of districts of Nepal. The geographic location details are given in the map below.



The biogas units' technology is best suited to the warm climate below 2,000 m altitude. Therefore, the biogas units are located mostly in the Terai and the Hill districts of Nepal[3]. The data on each biogas digester unit in terms of its unique identification code, name of household, address of the household, size of plant, date of construction, and name of the construction company have been collected and archived. AEPC and BSP-Nepal maintains the database of installed biogas units under the project activity. The biogas units are monitored over the lifetime of the project. The database is available upon request. The Digesters are within the host party spreading from North 26.20 degree to North 30.45 degree latitude and east 80.07 degree to East 88.20 degree longitude and the digesters identified with unique pipe numbers.

A.3. Technologies/measures

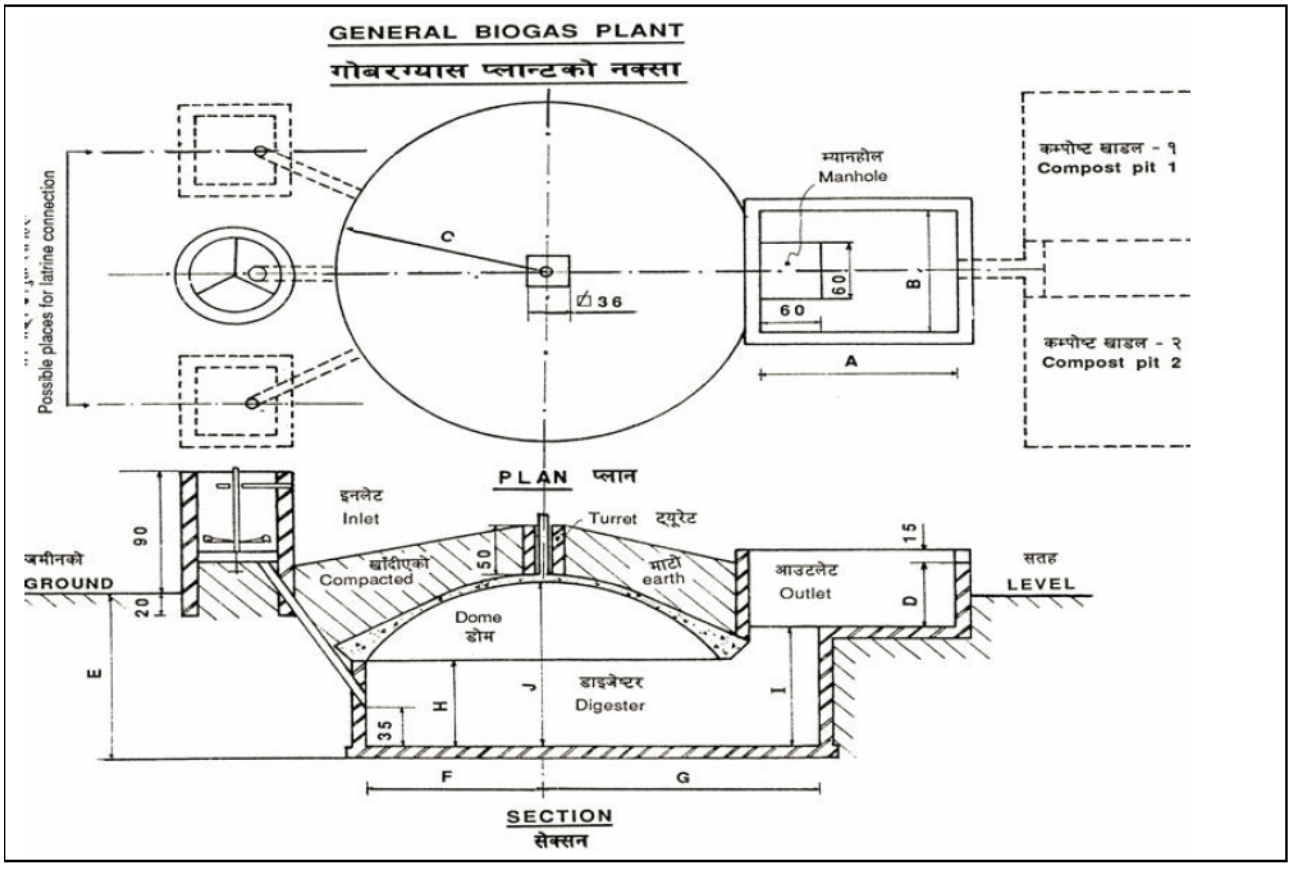
The existing traditional stoves used in the baseline are simple structures made from clay or having stone or metal tripods with poor combustion air supply or flue gas ventilation system i.e. without a grate or a chimney. These stoves use non-renewable biomass (firewood).

[3] The regions located at the elevation from 100 to 500 above sea level are the Terai; the regions located at elevations ranging from 500 to 3,000 m above sea level are the Hills; and the regions located at elevation ranging from 3,000m up are the Mountain.

The household biogas digester units to be sold under this project activity will provide biogas for the thermal energy needs of households with at least 2 heads of cattle (cow or buffalo) and will displace fossil fuel and/or non-renewable biomass products (firewood). Farming households living in villages in remote areas are the primary buyers of biogas units. The biogas units are based on a uniform technical design and are manufactured and installed following technical standards established in Nepal. The households will feed the dung of cattle (cows or buffaloes) mixed with water into the biogas plant, which through anaerobic digestion will produce biogas. The retention time of the slurry inside the tank is around 3 months. The figure below shows the technical design of the biogas plant.

Biogas household biogas digester units have been developed and produced in Nepal. Currently private companies produce biogas units. All biogas digester and appliance units except the main valve are produced locally, and are of good quality. Regarding the main valve, the limited biogas market does not justify the necessary investment for local production as yet; therefore the valves are imported from the Netherlands, Italy and/or Thailand. BSP-Nepal also provides R&D support and technical assistance to the individual companies. Over the last few years technology transfer has been facilitated, most notably through a long-term technical assistance program of the SNV (Netherlands Development Organization). The activities supported through this technical assistance have developed a large domestic knowledge base on construction, operation, and maintenance of high quality biogas units. The project activity promotes the biogas digester ranging from 2 m^3 to 10 m^3 with the operational life of 20 years. Different parts of the biogas digester are given in the Figure below.

Figure A.4.2



The target group of the BSP are households with at least two heads of cattle (generally cows or buffalos) who currently use non-renewable woody biomass (firewood) and/or fossil fuels (kerosene and/or LPG) for cooking purposes. The project aims to utilize the methane produced from household biogas digesters to replace the non-renewable energy sources that is used by households. The main feedstock for digesters is cattle manure and human excreta. Digesters are

available in different sizes. The size of the digester suitable for a given household depends on the number of people living in the house and the number of heads of cattle present.

The technology is environmentally sound. The digesters provide a decentralized source of energy and bring sustainable development benefits. The project also contributes to technology transfer since the technology is based on a Chinese design which has been tailored to the Nepalese situation with support of the Netherlands Development Organization SNV.

A.4. Parties and project participants

Parties involved	Project participants	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Nepal (Host)	Alternative Energy Promotion Centre (AEPC)	No

Each biogas household is the participant of the project who decides to invest in a biogas plant and owns emissions reductions generated thereafter. All but two households as listed above agree by contract to transfer the CO_2 credit and all other rights associated with the transaction and administration of these ERs to the Alternative Energy Promotion Centre.

AEPC, the project sponsor, is a government body under the Ministry of Energy Water Resource and Irrigation and oversees the policy design and promotion of the national renewable energy sector, of which biogas program is a part.

A.5. Public funding of project activity

The project activity is a sub-project of the BSP-Nepal umbrella biogas program that received funding from Parties namely the German Development Bank (KfW) and the Directorate General for International Cooperation of the Government of the Netherlands (DGIS) through SNV as well as funding from Government of Nepal (GoN) through the Alternative Energy Promotion Center (AEPC). The providers of the public funding will not purchase any emission reductions generated by the proposed project and affirms that the funding of the project activities for the biogas program has not resulted in the diversion of ODA and that this funding is not counted towards the financial obligation of the concerned Parties. Additionally AEPC has also affirmed the same understanding regarding this funding.

A.6. History of project activity

The project activity (Ref: 0136) was registered registered as a project activity on 27 December 2005 and the project has successfully completed second crediting period. The project activity is proposed for third crediting period renewal. This project activity is neither registered as another CDM project activity nor included as a component project activity (CPA) in a registered CDM programme of activities (PoA). The proposed CDM project activity is neither a project activity that has been deregistered nor CPA that has been excluded from a registered CDM PoA.

A.7. De-bundling

The project activity is not a de-bundled component of the BSP-Nepal umbrella biogas program according to the “de-bundling” rules specified in Appendix C of the simplified M&P for small-scale CDM project activities and the Guidelines on assessment of de-bundling for SSC project activities (version 03, EB 54, Annex 13). According to the rules, a small-scale project is a de-bundled component of a larger project if there is a registered small-scale activity or an application to register another small-scale activity:

- In the same project category and technology/measure;
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

The project participants of the proposed project are different from the project participants of another similar sub-project under the BSP-Nepal umbrella that has an application to be registered as a small activity, thereby clearly demonstrating that the project is not a de-bundled component.

SECTION B. Application of selected methodologies and standardized baselines

B.1. Reference to methodologies and standardized baselines

The title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity are as follows:

Title: Type I - Renewable energy project
Reference: AMS-I.E – Switch from Non-Renewable Biomass for Thermal Applications by the User, Version 09,
The detail of the methodology can be accessed from the UNFCCC website:
http://cdm.unfccc.int/methodologies/DB/IO5FJLJFWT91R6B8SO5BC7TXSK27I2

B.2. Applicability of methodologies and standardized baselines

The biogas digester represents a renewable energy intervention of the project to replace the non-renewable fuels and falls under the Type I (renewable energy) project category. The project was registered using the methodology AMS I.C. Thermal Energy for the User (Version 6). A revision (version 07) of methodology, AMS-I.C no longer included reference to projects that "displaces non-renewable biomass". The Government of Nepal strongly advocated for the inclusion of biogas project that displaces non-renewable biomass under the CDM project and advocated for the development of new methodology. The deadlock was cleared at the thirteenth COP/MOP in 2007 due to active advocacy by the Government of Nepal with support from different stakeholders. Subsequently, the AMS I.E was approved at the 37th EB meeting. The approved methodology AMS I.E is eligible for the projects activities that displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies (e.g. sand filters followed by solar water disinfection; water boiling using renewable biomass).

Therefore, the methodology AMS-I.E - Switch from Non-Renewable Biomass for Thermal Applications by the User, Version 04 was used for the project during second crediting period. The project activity conforms to the Procedures for renewal of the crediting period of a registered CDM project activity, Version 06 (EB63, Annex 29). The same methodology with version 9.0 is applied for crediting period renewable for the third crediting period. The applicability of the methodology is outlined as below:

Criteria AMS-I.E.	Explanation
Small-Scale project requirement: for biomass, biofuel and biogas project activities, the maximum limit of 15 $MW_{(e)}$ is equivalent to 45 MW thermal output of the equipment or the plant (e.g. boilers). For thermal applications of biomass, biofuels or biogas (e.g. the cookstoves), the limit of 45 MWth is the installed/rated capacity of the thermal application equipment or device/s (e.g. biogas stoves)[4]	This project includes 9,692 small biogas digesters installed during the period November 1, 2003 to June 15, 2004. The power equivalent of the installed biogas units ranges from 1.16 kW to 2.32 kW and the total installed equivalent generation capacity of the proposed project activity totals 14.73 MW which is less than the limit of 45 MWth. Since the number of biogas units included in the project activity is fixed and did not change during the second crediting period the threshold requirement would be complied with during the third crediting period.

[4] Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories, Version 10, paragraph 7c

This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies (e.g. sand filters followed by solar water disinfection; water boiling using renewable biomass).	The biogas cook stoves used in the project are indeed "activities to displace the use of non-renewable biomass by introducing renewable energy technologies". AMS-I.E. even lists biogas stoves as an example of eligible end user technologies.
Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods.	The biogas users survey (BUS) carried out in 2017 demonstrated that non-renewable biomass has been used since 31 December 1989. In that survey the respondents were asked to provide averages for the time needed to gather firewood, the distance travelled and the price before 28 years (Table- 11 and Table 12 of BUS 2016/2017 report). The average of the estimates from all respondents, showed a clear increase on all three indicators

B.3. Project boundary, sources and greenhouse gases (GHGs)

According to AMS-I.E, the project boundary is the physical, geographical site of the use of biomass or the renewable energy. At the unit level, the project boundary is defined by the individual sites and refers to the operation of the biogas digester units at the household level. Table B.4.1 shows the emission sources that are under the control of the project participants and attributable to biogas digesters. Figure B.4.1 and B.4.2 show the physical relation between the emission sources and the project boundary.

Source		GHG	Included?	Justification/Explanation
Baseline	Emissions from NRB use for cooking	CO_2	Yes	Main emission source.
		CH_4	No	Excluded for simplification. This is conservative.
		N_2O	No	Excluded for simplification. This is conservative.

	Emissions from fossil fuel use for cooking	CO_2	No	Excluded for simplification. This is conservative
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative.

Project activity	Emission from digester and biogas cooking stove	CO_2	No	This is not required by AMS.I.E
		CH_4	No	This is not required by AMS.I.E
		N_2O		

Figure B.4.1: Baseline emissions. Sources of GHG emissions and uses

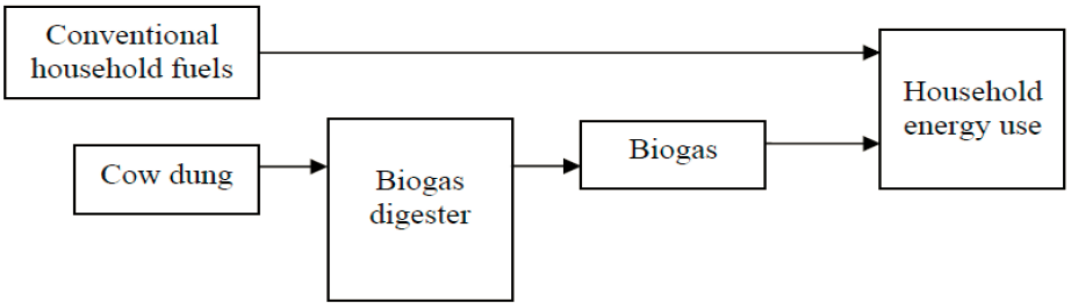


Figure B.4.2: Project emissions. Sources of GHG emissions and uses

B.4. Establishment and description of baseline scenario

As per the per the Procedures for renewal of the crediting period of a registered CDM project activity, Version 06 (EB63, Annex 29) and as per paragraph 286 of the CDM Standard for project activities version 2, the demonstration of the validity of the original baseline or its update does not require a reassessment of the baseline scenario, but rather an assessment of the emissions which would have resulted from that scenario. For cooking, rural households use non renewable biomass as firewood, cow dung and agricultural waste. The use of fossil fuels like kerosene and LPG is insignificant. Research indicates that use of firewood has a low sensitivity to economic determinants. As the small scale project activity displaces the use of non renewable biomass by introducing a renewable energy technology, AMS-I.E, Version 09 is used to estimate the emission reductions for the third crediting period. According to AMS-I.E, Version 09, “in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs”. As per the methodology, the baseline scenario adopted for the project is the use of fossil fuels for thermal energy applications. This is a conservative approach to determine the baseline scenario. For the third crediting period, the Methodological tool “Assessment of validity of the original/current baseline and update of the baseline at the renewal of a crediting period” Version 03.0.1 (EB 66, Annex 47) is used to assess the continued validity of the original baseline. This tool provides a stepwise procedure to assess the continued validity of the baseline and to update the baseline at the renewal of a crediting period.

Step 1: Assess the validity of the current baseline for the next crediting period

The “Procedures for the renewal of the crediting period of a registered CDM project activity” requires assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline.

Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies

There are no mandatory national and/or sectoral policies that affect the baseline scenario during the renewal of the crediting period.

The fundamental elements of the baseline have not changed since the project was first registered. The relevant national and sectoral policies for the promotion of the biogas digester in the Nepal are the Rural Energy Policy, the Renewable (Rural) Energy Subsidy Policy and the Renewable (Rural) Energy Subsidy Delivery Mechanism.

The Rural Energy Policy was published in the year 2006. The Renewable (Rural) Energy Subsidy Policy was initially published in 2000 (prior to project start date) and latest revision has happened in 2016. Similarly, the Renewable (Rural) Energy Subsidy Delivery Mechanism was initially published in 2000 (prior to project start date) and latest revised in 2017.

The Renewable (Rural) Energy Subsidy Policy has made provisions of financial subsidy support for the installation of the household biogas plants. The Rural Energy Policy has put emphasis to increase efficiency, reduce cost of the household biogas production technology, and to promote it in high mountains.

The Renewable (Rural) Energy Subsidy Policy 2016 has made provisions of financial subsidy support for the installation of the household biogas plants in the range from 2, 4, 6, m^3 and above. The subsidy support is categorised based on the location of the biogas plants in the Terai (Southern Plains), Hills and Remote Hills. The subsidy support provided would cover a maximum of around 40% cost of installation of the biogas plants.

The Renewable (Rural) Energy Subsidy Delivery Mechanism, prepared based on the Subsidy Policy, has made arrangements to channel the subsidy to the biogas users through the pre-qualified biogas companies, which provide installation and after sales services related to biogas as per the standard and guidelines approved by the AEPC.

The above policies only provide the incentives for the installation of household biogas plants and do not provide any obligations or enforced targets, nor do they ban the use of fuel wood for cooking. The baseline scenario established for the project is therefore still valid.

Step 1.2: Assess the impact of circumstances

There is no impact of circumstances existing at the time of requesting renewal of the crediting period on the current baseline emissions.

As demonstrated in Step 1.1, the promotion of household biogas plants through national policies set up is on voluntary basis. The Renewable (Rural) Energy Subsidy Delivery Mechanism is part of the package design to enhance the Biogas Support Program. No other market transformation activities or circumstances outside the implementation of the BSP have influenced households shift from non-renewable biomass for cooking in rural areas or the shift to rural households biogas plants using renewable biomass. The deployment of BSP has continued during the first crediting period of the Project Activity 1 with subsequent development of Project Activity 2, Project Activity 3, Project Activity 4 and Nepal Biogas Support Programme-PoA using the same baseline as used in the Project Activity 1. As described in Step 1.3, despite the policies, NRB continue to be the main energy source for cooking in rural areas. This is confirmed by the Biogas Users Survey 2017/18 for the Project Activity 1. The conditions used to determine the baseline emission in the previous crediting period are still valid.

Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested

This sub-step is applicable to the project activity since the baseline is the continuation of the existing practice, i.e. the households will rely on traditional cook stoves using non-renewable biomass in the absence of the project activity. The traditional stoves made from local materials are expected to continue in the absence of the project. Therefore, the continued use of baseline materials is possible.

To confirm that NRB based cook stoves continue to be used, the project participants conducted a survey to check whether the firewood replaced by the digesters is subject to the trends defined in AMS-I.E.: version 09 increasing amount of time needed or distance travelled for firewood gathering, increasing firewood prices or changes in the type of firewood used. The indicators selected to monitor the continued displacement of NRB in the project are:

1) Increase in time needed to gather firewood or increase in distance travelled to gather firewood
2) Increasing trend in fuel wood price.

The Biogas Users Survey 2017/18 reveals the following:

- Increase in time and distance travelled to gather firewood. The time required to reach the forest, collect one bundle of fire wood and return back now is 37 minutes; 145 minutes and 40 minutes respectively., whereas in 2000 it was 34 minutes, 121 minutes and 38 minutes respectively. Likewise, in 1989; it was 32 minutes, 110 minutes and 35 minutes respectively. This indicate that the sourcing biomass from forest over the years have become even more difficult.

- Increase in fuel wood price: The results reveal that the average market price of one bhari[5] of fuel wood in 1989 was NPR 36which rose to NPR 485in 2018. Contemporary price of fuel wood is more than 2.5 times the price in 2000 when the price was NPR 176/bhari

If the operational lifetime of the biogas digesters is completed within this crediting period, that particular biogas digester will not be considered for the baseline emission calculation from the next consecutive monitoring period. As it can be seen that, the continuation of use of current baseline equipment, (non-renewable biomass based cook stove) is the most likely scenario for the crediting period for which renewal is being requested.

Step 1.4: Assessment of the validity of the data and parameters

There are some parameters such emission factors per fuel source (IPCC default values), emission reduction factor of the biogas units, which were determined at the start of the first crediting period and not monitored during the first crediting period, are not valid anymore. AMS-I.E, Version 09 provides new guidance on key parameters, different default values and emission reductions calculation formulas. So the current baseline was updated for the third crediting period according to the AMS-I.E, Version 09. Application of Steps 1.1, 1.2, 1.3 and 1.4 confirmed that the current baseline is valid for the second crediting period, but data and parameters needs to be updated. Therefore step 2 is used.

Step 2: Update the current baseline and the data and parameters

Step 2.1: Update the current baseline

The baseline emissions for the third crediting period have been assessed based on the latest approved version of the AMS-I.E (Version 09). More details on the updated baseline emissions for the third crediting period can be seen in section in B 6.3.

Step 2.2: Update the data and parameters

As mentioned in step 1.4 above, many default parameters have been updated and new parameters have been used (as per AMS-I.E Version 09) for this third crediting period. More details can be seen in sections B.6 and B.7 on the monitoring parameters relevant for the third crediting period.

[5] 1 Bhari is about 35 kg in an average

B.5. Demonstration of additionality

A small-scale CDM project activity is additional if anthropogenic emissions of greenhouse gases by sources are reduced below those that would occur in the absence of the registered CDM project activity and the project activity is facing one or more barriers as defined in Attachment A to Appendix B of the simplified modalities and procedures for small-scale CDM project activities and Non binding best practice examples to demonstrate additionality for SSC project activities (EB 35, Annex 34). Several barriers related to investment and technology is described below that hinder the development of the bundle of small-scale biogas digester projects as CDM activities.

The additionality of the proposed project below is demonstrated in two steps. Since the proposed project activity is a sub-activity of the BSP-Nepal Umbrella Biogas Program, the first step examines the issue of additionality at the level of the umbrella program aiming to install all 200,000 new biogas units. The second examines the additionality issue at the level of the households to be enrolled in the project.

Investment barrier at the level of the national program

The Biogas Support Program (BSP) was started in July 1992 with the support of international donor funding by KfW and DGIS (through SNV) and has been implemented in phases. The Phase I of the project was implemented from 1992 to 1994 (construction of 6,824 biogas units), Phase II from 1994 to 1997 (construction of 13,375 biogas units), Phase III from March 1997 to June 2003 (construction of 91,196 biogas units) and Phase IV from July 2003 onwards. The biogas plant installed during the Phase IV program has been developed as different CDM projects. However, despite these past achievements, investing in a biogas plant remains a non-commercial activity in Nepal, as demonstrated in the next section. Furthermore, by the end of the third phase (June 2003), KFW and DGIS decided to gradually phase out their support to the biogas program by 2009 (DGIS subsequently phased out its support from December 2010). Therefore, under this scenario, the fourth phase came into existence as a CDM project activity with the aim of making the biogas sector a commercially sustainable sector through integrating carbon revenues benefiting a large rural population. The biogas plants installed between 1/11/2003 – 15/6/2004 was developed as BSP – Activity 1, the biogas plants installed between 16/6/2004 – 6/4/2005 was developed as BSP – Activity 2, the biogas plants installed between 7/4/2005 – 8/5/2006 is developed as BSP – Activity 3 and the biogas plants installed between 9/5/2006 – 21/6/2007 is developed as BSP – Activity 4. The biogas plants installed from 22/06/2007 onwards have been developed as the PoA project.

The following are the interventions of the fourth phase:

- Financial support for end-users through micro-finance institutions and cooperatives;
- Uniform technical design of biogas units;
- Thorough quality control and monitoring of the production, installation and after-sales services of the participating biogas companies;
- Continuous research & development efforts to optimise plant operation and to tailor the biogas units to the needs of the end-users;
- Social marketing through outreach, awareness, and training programs;
- Implementation of fertilizer extension program to maximize the benefits of bio-slurry, a byproduct of the biogas;
- Support to institutions servicing various functions of the biogas sector such as financing, construction, maintenances, manufacturing, training, and marketing, and
- Installation of biogas units on a scale that demonstrates CDM application in the commercialisation of the biogas sector.

Without the CDM, the biogas sector in Nepal would diminish as the donors' support shrinks. By implementing the above approaches, all 200,000 biogas units are to be installed in rural households over a period of several years, creating "a learning by doing" opportunity to utilize the CDM funding mechanism to promote biogas sector in Nepal. Making biogas units financially accessible on a large scale while maximizing their socio-economic and carbon value would create an economic basis for future biogas sector investments. The optimisation of the technological

performance through R&D and rigorous quality control would build a sound technological base. In addition, the institutional development functions of the biogas sector, such as financing, construction, maintenances, manufacturing, training, and marketing, would establish the sustainability of the biogas sector.

The implementation of the fourth-phase umbrella requires a total finance of US$ 25.3[6] million. The cost of subsidies totals US$ 20.5 million, and the operations and maintenance cost is US$ 4.8 million.

The government of Nepal (through AEPC) along with the German Development Bank (KfW) and the Directorate General for International Cooperation of the Government of the Netherlands (DGIS) provide total funding of US$ 19.7 million for upfront capital for program implementation. This funding constitutes a US$ 9.15 million contribution from KfW, US$ 4.92 million from DGIS/The Government of the Netherlands, and US$ 5.61 million from HMG/Nepal. Even with these funding contributions, the project proponent still faces a shortfall of US$ 5.6 million that the Nepali government is unable to cover. Thus, the carbon finance will fill the financing gap due to a reduction in donor support.

The program faces an investment barriers and an institutional barrier at the programme level. The BSP is not commercially viable and requires donor funding. Still, even with donor funding the program has been facing a budget deficit and future budgets show that this deficit will increase further for two reasons: program funding is decreasing and the investment barrier that households face is increasing and requires higher subsidies to overcome. The budget deficit is planned to be overcome through CDM revenues.

Donor funding is decreasing. Funding can be divided in program funding (for program management and the provision of post-installation services) and subsidy funding (providing financial investment support to the households). In general donors are more willing to provide funding for subsidies as it is easier to monitor the proper use of these funds. The only donor that has provided funding for the program is DGIS. DGIS has stopped the funding for the program from December 2010, creating a lack of financial means for program management, maintenance and the distribution of subsidies. Carbon revenues to be earned are expected to fill this gap.

By combining carbon revenues earned from selling the generated ERs with the donor support, it will be possible to build upon the previous efforts to develop the biogas sector. At the time of reaching the agreement to provide funding support to the fourth-phase, both KfW and DGIS/SNV fully recognized that biogas units have a GHG mitigation potential achievable under the CDM, and the income from the sales of GHG emission reductions could help achieve the fourth phase target of installing 200,000 biogas units.

Investment barrier at the level of households

The high up-front investment cost of a biogas plant is a barrier for poor cash-strapped farmers in Nepal. Depending on size and location, a biogas plant costs between US $251 and $393 (Table B.3.1).
For a Nepali farmer, the conventional and least cost cooking technology is the traditional or improved stove burning a combination of firewood, agricultural residue, and animal manure. The conventional lighting fuel is kerosene used in small wick lamps. Tea shops and a few families living in towns or next to motorable roads where firewood is likely to be scarce, kerosene in pressure stoves is used for cooking in market areas. Both the traditional stove and the improved cook stove are low-cost devices constructed from local materials. The total cost of an improved stove can range from US$3-6 and the cost of a kerosene stove ranges from US$6-8[7].

[6] An exchange rate of 1US$=73 NRs is used in throughout the PDD

[7] The cost of constructing an improved cook stove depends on the design used. $1-2 of steel 'reinforcement' is often used. Other construction materials, such as stone and clay, are locally available. A trained stove builder will charge between $2-4 to construct the stove

The high up-front investment cost of a biogas plant inhibits a poor farmer from adopting the technology, making the subsidy provided under the proposed project an essential economic incentive for farmers deciding to purchase a biogas plant. The subsidies range from $73 in the Terai to $113 in the Hills (Table B.3.1). The higher levels of subsidy in the Hills and mountain areas are intended to compensate for higher costs of construction, relatively lower gas production, and less likelihood of fuelwood purchase in those locations. The subsidies are greater for 4m^3 and 6m^3 units than for 8m^3 and 10m^3 units. This is to encourage poorer farmers who have fewer cattle and are less likely to pay for firewood to purchase units.

Table B.3.2: Cost of biogas units in Nepal (US$)

Size (m3)	Location	Average Cost	Subsidy	Net Cost
4	Terai	251	73	178
4	Hill	261	113	148
6	Terai	284	73	211
6	Hill	295	113	182
8	Terai	335	67	268
8	Hill	350	107	243
10	Terai	376	67	309
10	Hill	393	107	286

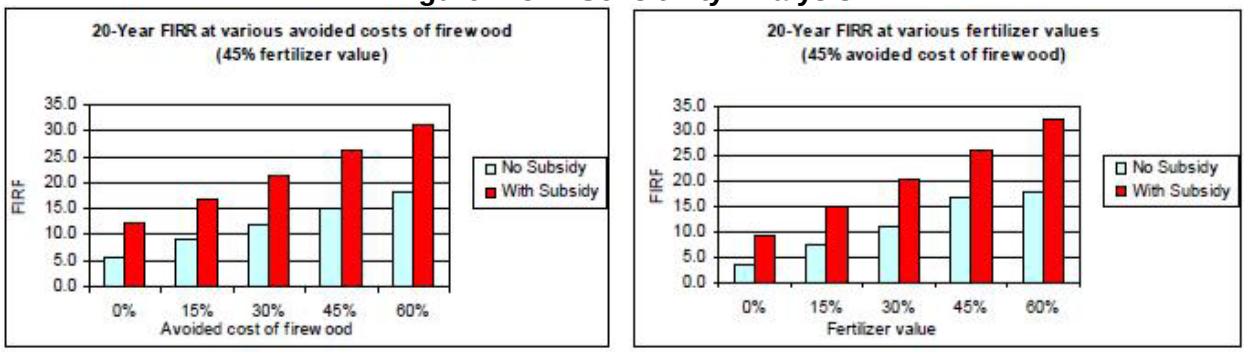
Source: Winrock International 2004.

The earlier phases of the BSP-Nepal program targeted more accessible areas where a higher percentage of households purchase cooking fuel. The proposed project aims to introduce new units in more remote communities where the majority of households would not purchase firewood in the absence of the project activity. Although the percentage is not precisely known, existing studies and consulted experts are in agreement that the large majority of farmers acquire firewood at no monetary expense.

Only a minority of rural Nepali households – primarily those living in market towns or next to motorable roads – purchase firewood in the market or cook with kerosene or LPG. The majority collects fuel from the closest forest. Firewood can be costly if purchased at the official government price of about US$ 0.02/kg of wood and a liter of kerosene costs US$ 0.46, whereas biogas has no running costs except the cost of labor to feed manure into the plant and to maintain the plant. The average annual maintenance cost of the biogas plant is about US$2.

The analysis below shows that the 20-year Financial Internal Rate of Return (FIRR) of an average 6 m^3 plant is sensitive to two kinds of annual cost savings that a participating farmer would achieve by investing in a biogas digester. These savings are the avoided cost of firewood and the avoided purchase of inorganic fertilizer as a result of the use of biogas slurry (bio-slurry).

Figure B.3.1: Sensitivity Analysis



In this analysis, a biogas digester investment is considered financially attractive if the FIRR (20-year) is higher than the interest rate (cost of capital) for plant installation, i.e. 15%. Without the

subsidy, the FIRR values indicate that the investment is only profitable under one of the following scenarios.

a) the household would purchase none of its firewood consumption but would realize 85% of the fertilizer benefits from bio-slurry;
b) the household would purchase 45% of the firewood consumption and realize 45% of the fertilizer benefits; or
c) the household would purchase 100% of the consumed firewood but would realize no fertilizer benefits.

A recent BSP-Survey reports that a household in Hill region using a biogas digester unit would purchase on average 11.5% less firewood annually compared to the amount that it would have purchased without a biogas digester unit and would achieve little or no benefits in terms of bio-slurry value (the remaining firewood collected at no expense). Since the bio-slurry use is a new practice in Nepal, this study also indicates that the sampled households did not have confidence in this new source of fertilizer to reduce purchase of commercial inorganic fertilizers; consequently, the households realized little financial value from the bio-slurry use. The Tarai households are expected to purchase a greater percentage of firewood, thereby potentially achieving greater savings from avoided firewood purchase by using a biogas unit relative to the households in the Hill region due to the scarcity of available firewood in Tarai region[16]. Nevertheless, given the minimal fertilizer benefits that the biogas households are realizing from the bio-slurry, it is extremely unlikely that a Tarai household would realize at least 47% of fertilizer value from the bio-slurry, which is required for a profitable investment. A household that would achieve no financial value from bio-slurry use would only regard the biogas investment as profitable if it had purchased at least 95% of the amount of annually consumed firewood. However, this scenario is unlikely as well considering the households collect firewood from non-renewable biomass. This strongly indicates that the targeted farmers in both Tarai and Hill would not invest in the biogas digester unless they would receive a subsidy that fills their cost gap.

With the subsidy provided in the project case, even if no value from fertilizer displacement is achieved, 15% avoided cost of firewood would result in a break-even, and a 30% avoided cost of firewood would result in a FIRR of about 7%. Conversely, for households that would have purchased no firewood, 15% of the fertilizer benefits would result in break-even and 20% of fertilizer in a FIRR of 1.3%. The project is expected to increase fertilizer benefits of the bio-slurry for the participating households through a planned fertilizer extension program. The project through social marketing activities will further enable these households to incorporate non-monetized benefits of the biogas use, such as savings of time and improved health through reduced indoor smoke and improved sanitation. Thus, the subsidy provision along with social marketing and fertilizer extension activities under the project would provide socio-economic incentive a household to participate in the biogas program.

Technology barrier

A well-known barrier for the dissemination of biogas digesters worldwide is the poor quality of biogas systems. In the absence of a proper quality control program, suppliers of biogas units would compete solely on price. Users cannot determine the quality of biogas units. Thus, without the proposed CDM project activity, biogas companies would have an incentive to save on costs and provide poor quality systems. The dissemination of low-quality biogas units would lead to lack of trust in the technology, resulting in a vicious circle of low demand for biogas units and fewer margins on biogas digester sales. This is a barrier to the successful adoption of the biogas digester technology in Nepal. Currently, in addition to the subsidy that it administers, BSP-Nepal provides quality control on all units constructed by participating companies. In fact, it is this “carrot” and “stick” approach that results in high quality units in order to make sure that high quality biogas units are installed. CDM revenues can support this quality control and assurance function of BSP-Nepal necessary to maintain the construction standard and, subsequently, the performance of the technology.

In essence, without carbon revenues, the Nepali government's program to make the biogas sector a commercially viable would be in jeopardy and would most likely not achieve its program objectives. It is evident that the most likely scenario in the absence of the project activity is that the households to be enrolled in the project would continue to use non-renewable biomass to meet the cooking energy needs and dispose the manure from cattle as per conventional practices.

B.6. Estimation of emission reductions

B.6.1. Explanation of methodological choices

The small-scale methodology, AMS-I.E, Version 09 has been adopted for the third crediting period as per the requirement of the Procedures for the renewal of the crediting period of a registered CDM project activity" version 06. Details assessment is provided in B.4. The AMS-I.E, Version 09, is used to demonstrate the emission reductions achieved based on the quantity of non-renewable biomass substituted with the biogas digester units of the project.

According to methodology AMS-I.E. version 09 para 20, baseline emission reductions would be calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel} \quad \text{Equation (1)}$$

Where:

ER_y	Baseline emissions during the year y in tCO_{2e}
B_y	Quantity of woody biomass that is substituted or displaced in tonnes
$f_{NRB,y}$	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non renewable biomass
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel: 0.0156 TJ/tonne)
$EF_{projected\_fossilfuel}$	Emission factor for substitution of non renewable woody biomass by similar consumers. Use a value of 63.7 tCO_2/TJ

B_y can be determined by using one of the following options.

(a) Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity (tonnes/household/year).
(b) Calculated as the product of the number of persons served per household multiplied by the number of households and the estimate of the average annual consumption of woody biomass per person that is displaced by the project activities (tonnes/person/year).
(c) Calculated as the product of the number of persons served per institution[8] multiplied by the number of institutions and the estimate of average annual consumption of woody biomass per person that is displaced by the project activity (tonnes/person/year).

The methodology requires choosing one of the three options mentioned above for calculating the "Quantity of woody biomass that is substituted or displaced". Option a) has been selected, as it is feasible to determine By based on number of households multiplied by the estimate of average annual consumption of woody biomass per household substituted (tonnes/household/year) derived from historical data or estimated using survey methods.

As per para 21a of the methodology, By can be calculated as,

[8] Institutions such as schools, prisons and hospitals

$$B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$$ Equation (2)

Where:

N_{HH}	=	Number of households in the project activity, number
$BC_{BL,HH,y}$	=	Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year
$BC_{PJ,HH,y}$	=	If it is found that pre-project devices were not completely displaced but continue to be used to some extent, average annual consumption of woody biomass per household in the pre-project devices during the project activity, tonnes/household/year

The survey was done to identify the average annual consumption of woody biomass per household substituted in 2018 for Project Activity 1. The survey has found that the woody biomass consumption is 5.06 tonnes/household/year before the project activity whereas 0.55 tonnes/household/year of the woody biomass consumption is found after the project activity. It means net annual average woody biomass displaced per household is 4.51 tonnes/household/year.

The Survey was conducted based on the "Sampling and surveys for CDM project activities and programmes of activities" Version 04.0 appendix 1 para 24 and obtained the samples as 72 however the sample size is increased to 90 for conservative purpose. The Biogas User Survey of 2017/18 for the project activity is submitted for validation.

Differentiation between NRB and renewable biomass and determining $f_{NRB,y}$

The methodology requires the Project Participants to determine the shares of renewable and non-renewable woody biomass in By (the quantity of woody biomass used in the absence of the project activity); the total biomass consumption using nationally approved methods (e.g. surveys or government data if available) and then determine $f_{NRB,y}$ as per TOOL30: Calculation of the fraction of non-renewable biomass (EB 97, Annex 9).

As per the tool, the shares of renewable and non-renewable woody biomass in the quantity of woody biomass consumption shall be determined following the steps described below:

$$fNRB = \frac{NRB}{NRB + RB}$$

where

f_{NRB} : Fraction of non-renewable biomass (fraction or %)
NRB : Quantity of non-renewable biomass (t/yr)
RB : Quantity of renewable biomass (t/yr)

The quantity of the NRB can be determined by calculating the total consumption of wood in the country or region and then deducting the quantity of renewable biomass from it.

$$NRB = H - RB$$

Where

H : Total annual consumption of wood in the absence of the project activity (t/yr)

The total quantity of wood consumption is provided by the Ministry of Forest and Environment of Government of Nepal which is estimated as 128 Million Tonnes/Year. Renewable biomass (RB) in the country/region/area is estimated using the equation below:

$$RB = \sum \left(MAI_{forest,i} \times (F_{forest,i} - P_{forest}) \right) + \sum \left(MAI_{other,i} \times (F_{other,i} - P_{other}) \right)$$

Where:

$MAI_{forest,i}$	=	Mean Annual Increment of woody biomass growth per hectare in sub-category *i* of forest areas (t/ha/yr)
$MAI_{other,i}$	=	Mean Annual Increment of woody biomass growth per hectare in sub-category *i* of other wooded land areas (t/ha/yr)
$F_{forest,i}$	=	Extent of forest in sub-category *i* (ha)[4]
$F_{other,i}$	=	Extent of other wooded land in sub-category *i* (ha)[4]
P_{forest}	=	Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within forest areas (ha)[5]
P_{other}	=	Extent of non-accessible area (e.g. protected area where extraction of wood is prohibited, geographically remote area) within other wooded land areas (ha)[5]
i	=	Sub-category i of forest areas and other wooded land areas

The forest area and the other wooded land area are taken from the "State of Nepal's Forest" published by Ministry of Forest and Soil Conservation[9], whereas the mean annual increment of woody biomass is calculated using Global Forest Resources Assessment 2000 by the FAO for "Distribution of total forest area by ecological zone" (Table 14) and 2006 IPCC Guidelines for National Greenhouse Gas Inventories for "Above-ground biomass growth rates (t/ha-yr) for different ecological zones" (Chapter 4, Table 4.9) as suggested in the tool. As per the tool the, fraction of NRB is calculated as 86.1%.

Project Emissions

As per the AMS IE Version 09, the project emissions (PE_y) from cultivation, use and processing of biomass shall be calculated using the latest version of "TOOL16: Project and leakage emissions from biomass". In doing so, the following sources of project emissions shall be considered as applicable, bearing in mind that some sources may be only relevant for specific fuels (e.g. production of bio-ethanol):

a) CO_2 emissions from on-site consumption of fossil fuels due to the project activity, including the consumption of fossil fuels for any processing of feedstock;
b) CO_2 emissions from electricity consumption by the project activity including the consumption of electricity for any processing of feedstock;
c) Methane emission from solid waste disposal or waste water in cases where the waste is disposed in anaerobic conditions;
d) Project emissions related to cultivation of feedstock
e) Project emissions from transportation, if the transportation distance is more than 200 km; otherwise they can be neglected.

The fuelwood are basically sourced from the nearby and natural forest, which does not require processing of the feedstock and also does not include the cultivation, the above emissions are not applicable to this project activity. So, the project emission for this project activity is neglected and taken as zero.

Leakage emissions

[9] http://www.dfrs.gov.np/downloadfile/State%20of%20Nepals%20Forests%20(DFRS)_1457599484.pdf

As per the methodology, leakage emissions (LE_y) shall be calculated using the latest version of "TOOL16: Project and leakage emissions from biomass". According to the methodology, leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex-post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered:

a) The use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users that is attributable to the project activity then By is adjusted to account for the quantified leakage. Alternatively, By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.

In order to avoid expensive monitoring, the Project Participants have opted to use the default factor of 0.95 to account for any potential leakage, as prescribed by the methodology.

b) Project activities switching from baseline device using firewood to efficient project device using charcoal or switching from firewood to processed biomass (briquette, pellets, and woodchips) shall take into account the leakage effects related to the charcoal or processed biomass production.
The project does not involve any device using charcoal or processed biomass (Briquette, Pellets and woodchips), the above provision on leakage is not applicable.

Emission Reductions

As the methodology AMS IE version 09, para 27, the emission reduction are to be estimated based on the following equation:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

ER_y = Emission reductions in year *y*, tonnes CO_2eq

B.6.2. Data and parameters fixed ex ante

Data/Parameter	$f_{NRB,y}$
Data unit	%
Description	Fraction of woody biomass saved by the project activity during year y that can be established as non-renewable biomass
Source of data	Calculated as per "TOOL30: Calculation of the fraction of non-renewable biomass"
Value(s) applied	86.1 %
Choice of data or measurement methods and procedures	The value is calculated as 86.1% using the national statistics and also validated by the Ministry of Forest and Environment, Government of Nepal. This value is for the national level, so will not be monitored.
Purpose of data	Calculation of baseline emission
Additional comment	This parameter shall remain fixed for the crediting period.

Data/Parameter	$EF_{projected\ fossilfuel}$
Data unit	tCO_2/TJ
Description	Emission factor for the projected fossil fuel consumption in the baseline.
Source of data	IPCC
Value(s) applied	63.7
Choice of data or measurement methods and procedures	AMS-I.E. Version 09 requires using this value.
Purpose of data	Calculation of emission reduction
Additional comment	The value will be fixed for the crediting period

Data/Parameter	$\mathbf{N_{HH}}$
Data unit	Number
Description	Number of households in the project activity in year y
Source of data	BSP database
Value(s) applied	The project includes 9,692 digesters installed between November 1, 2003 to June 15, 2004, in various districts of Nepal as indicated in the table table A.1. Established ex ante prior to start of the project activity Out of the 9,708 plants installed and originally included in the project activity, 16 units of $6m^3$ size constructed in Makwanpur district (Hill region) have been reported during the monitoring (first crediting period) to be non-existing by the company in-charge of installing and maintaining the units, as a land slide damaged and displaced the whole village. These 16 plants are not included in the emission reduction calculation. Thus, the total number of plants in the project activity has reduced to 9,692 from 9,708 in second crediting period and is applicable for third crediting period as well
Choice of data or measurement methods and procedures	The registration procedure of the BSP database avoids double counting of digesters and the registration of digesters that have not been commissioned. The BSP database is the basis for subsidy disbursement.
Purpose of data	Calculation of baseline emission
Additional comment	During calculation of Emission Reduction, it will be based on actual number of households having the biogas operational

Data/Parameter	$BC_{BL,HH,y}$
Data unit	tonne/household/year
Description	Average annual consumption of woody biomass per household before the start of the project activity
Source of data	Based on survey (Biogas User Survey (BUS)) for the project activity.
Value(s) applied	5.06 tonne/household/year
Choice of data or measurement methods and procedures	Calculated using option (b) Historical data or a sample survey conducted as per the latest version of the "Standard:Sampling and surveys for CDM project activities and programme of activities;" Biogas User Survey follows the standard sampling and surveys indicated in the PDD registered for second crediting period.
Purpose of data	Calculation of baseline emission
Additional comment	This value is used in the calculations and shall remain fixed for the crediting period.

B.6.3. Ex ante calculation of emission reductions

The emission reduction calculation is based on data that is specified to digester size and region. This section provides a short explanation of the calculations made. Table A.1 provides an overview of the number of digesters in this project.

Emission reduction

As per para 27 of the AMS I.E version 9, the emission, reduction is estimated as follows:

$$ER_y = BE_y - PE_y - LE_y$$

where,

ER_y : Emission Reduction
BEy : Baseline Emission
PE_y : Project Emission
LE_y : Leakage Emission

Now,

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

The By is calculated as using the value as follows

N_{HH}	9692
$BC_{BL,HH,y}$	5.06 tonne/household/year[10]
$BC_{PJ,HH,y}$	0.55 tonnes/household/year[11]
Operational status of Biogas	100%[12]

By = 9692*100%*(5.06-0.55) = 43,807.84 tonne/year

Considering
$f_{NRB,y}$ = 86.1% (calculated using Tool 30: calculation of the fraction of non-renewable biomass
NCV biomass = 0.0156 TJ/tonne (as per the methodology AMS I.E version 9)
$EF_{projected\_fossil\_fuel}$ = 63.7 tCO_{2e}/TJ (as per the methodology AMS I.E version 9)

[10] Biogas User Survey 2017/18 for PA-1
[11] Biogas User Survey 2017/18 for PA-1
[12] For ex ante 100% is taken however actual operational status is arrived using sample survey for expost

Baseline Emission is calculated as BE_y = 37,481.68 tCO_{2e}

Considering the leakage of 5% (as per the methodology AMS I.E. version 9), leakage emission is calculated as LEy = 1874 tCO_{2e}

Considering the project emission (PEy) as zero as this is not applicable for this project activity, the emission reduction is calculated as 35,607 $tCO_{2e.}$

B.6.4. Summary of 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)
01/08/2018 - 31/07/2019	37,481	0	1,874	35,607
01/08/2019 - 31/07/2020	37,481	0	1,874	35,607
01/08/2020 - 31/07/2021	37,481	0	1,874	35,607
01/08/2021 - 31/07/2022	37,481	0	1,874	35,607
01/08/2022 - 31/07/2023	37,481	0	1,874	35,607
01/08/2023 - 31/07/2024	37,481	0	1,874	35,607
01/08/2024 - 31/07/2025	37,481	0	1,874	35,607
Total	**262,367**	0	**13,118**	**249,249**
Total number of crediting years	7 years			
Annual average over the crediting period	37,481	0	1,874	35,607

B.7. Monitoring plan

B.7.1. Data and parameters to be monitored

The various aspects that need to be monitored according to the methodology AMS-I.E, Version 09, and their applicability to the project are discussed below.

The biogas plants will be monitored continuously for non-usage. The emission reduction will be calculated only for usage days of all the constructed and operational units based on which $BC_{PJ,HH,y}$ will be determined and B_y calculated for each of the household.

Monitoring should confirm the displacement or substitution of the non-renewable woody biomass at each location. This shall be ensured by monitoring at least two of the following supporting indicators to exist:

• A trend showing an increase in time spent or distance travelled for gathering fuel-wood, by users (or fuel-wood suppliers) or alternatively, a trend showing an increase in the distance the fuelwood is transported to the project area;
• Survey results, national or local statistics, studies, maps or other sources of information, such as remote-sensing data, that show that carbon stocks are depleting in the project area;
• Increasing trends in fuel wood prices indicating a scarcity of fuelwood;
• Trends in the types of cooking fuel collected by users that indicate a scarcity of woody biomass.

,

Data/Parameter	Date of commissioning of project device of type i
Data unit	Date
Description	Actual date of commissioning of the project device.
Source of data	Internal database/records
Value(s) applied	-

Measurement methods and procedures	The registration procedure of the BSP database avoids double counting of digesters and the registration of digesters that have not been commissioned. The commissioning date is the basis for subsidy disbursement.
Monitoring frequency	Fixed and recorded at the time of commissioning
QA/QC procedures	This can be checked from the commissioning report and subsidy application form.
Purpose of data	Calculation of baseline emission
Additional comment	N/A

Data/Parameter	$NCV_{biomass}$
Data unit	TJ/tonne
Description	Net calorific value of the non-renewable woody biomass, briquettes or charcoal used in project devices
Source of data	Methodology AMS I.E. Version 09
Value(s) applied	0.0156
Measurement methods and procedures	De-fault value will be applied from the methodology AMS I.E version 09
Monitoring frequency	N/A
QA/QC procedures	N/A
Purpose of data	Calculation of baseline emission
Additional comment	N/A

Data/Parameter	$BC_{PJ,HH,y}$
Data unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent.
Source of data	Biogas User Survey
Value(s) applied	0.55 tonnes/household/year for the ex-ante calculation as per the Biogas User Survey 2017/18 for PA-1. For the crediting period, this parameter will be determined using regular user survey.
Measurement methods and procedures	Biogas User Survey will be conducted on a sample of households. The sample size is determined to achieve 90% confidence interval and a 10% margin of error. During the survey, the estimates of the biogas users on the average annual consumption of woody biomass during the monitoring period will be captured.
Monitoring frequency	At least once every two years (biennial)
QA/QC procedures	Though the methodology requires sample survey biannually, PP conducts the user survey annually to ensure the number of biogas digesters operational for that particular year.
Purpose of data	Calculation of baseline emission
Additional comment	ERs will be accounted only for functional biogas in the particular monitoring period

Data/Parameter	**B_y**
Data unit	tonnes/household/year
Description	Quantity of woody biomass that is substituted or displaced
Source of data	Biogas User Surveys to be carried out once in a year
Value(s) applied	Ranges from zero when biogas is not used to 5.06 tonnes/household/year and 49,041.52 tonnes/year for 9692 household, when $BC_{PJ,HH,y}$ is zero and all biogas are operational.

Measurement methods and procedures	The calculation of the By depends on the operational status of the biogas units for the particular monitoring period and the operational status will be checked annually during the Biogas UserSurvey. From the total population of biogas units included in the project activity, statistically representative samples will be drawn for the purpose of carrying out the survey. The sample size is determined to achieve 90% confidence interval and a 10% margin of error. The percentage of biogas units found to be operational during the sample survey shall be used to calculate the weighted average operational status of the biogas which then will be used to calculate By as follows: $By = N_{HH}*(BC_{BL,HH,y} - BC_{PJ,HH,y})$ where N_{HH} will be the household with operational biogas digester for the particular monitoring period.
Monitoring frequency	Once in a Year
QA/QC procedures	Every year, the Internal Quality Control System samples 5% of the digesters that are newly implemented in that year, 2.5% of the digesters that implemented a year before and another 2.5% of the digesters implemented two years before that particular year. However, since the digesters included in this project activity were implemented in 2003/2004 and the third crediting period is started only in 2018, results from the internal quality system will not apply to the project activity for future monitoring. This parameter will therefore be monitored as part of the annual biogas users' survey.
Purpose of data	Calculation of baseline emission
Additional comment	Once the biogas included in the project activity completes its operational lifetime of 20 years, those biogas will not be considered for the next consecutive monitoring.

Data/Parameter	Trends in distance travelled for firewood gathering or trends in time needed for firewood gathering indicating depletion of resources available
Data unit	-
Description	This parameter is use to confirm the displacement or substitution of the nonrenewable woody biomass at each location
Source of data	Biogas User Surveys
Value(s) applied	Increased distance and time spent for firewood gathering
Measurement methods and procedures	Annual Biogas User Survey will be conducted on a sample of households. The sample size is determined to achieve 90% confidence interval and a 10% marginof error. During the survey, the perceptions of the biogas users on the distance travelled and the time spent for firewood harnessing to price will be captured and analysed to show the depletion of resources.
Monitoring frequency	Once in a Year
QA/QC procedures	The number of households in the sample is increased to remedy the possibility of incomplete questionnaires. The surveyors are trained and supervised to minimize any bias.
Purpose of data	To confirm the displacement and substitution of the non-renewable woody biomass
Additional comment	N/A

Data/Parameter	Trends in price of firewood indicating demand and scarcity
Data unit	-
Description	This parameter is use to confirm the displacement or substitution of the nonrenewable woody biomass at each location
Source of data	Biogas User Surveys
Value(s) applied	Increased demand and scarcity of firewood

Measurement methods and procedures	Annual Biogas User Survey will be conducted on a sample of households. The sample size is determined to achieve 90% confidence interval and a 10% marginof error. During the survey, the perceptions of the biogas users on the price of firewood will be captured and analysed to show the increase demand and scarcity of firewood
Monitoring frequency	Once in a Year
QA/QC procedures	The number of households in the sample is increased to remedy the possibility of incomplete questionnaires. The surveyors are trained and supervised to minimize any bias.
Purpose of data	To confirm the displacement and substitution of the non-renewable woody biomass
Additional comment	N/A

Data/Parameter	Trends in type of cooking fuel collected that could indicate scarcity of fire wood
Data unit	-
Description	This parameter is use to confirm the displacement or substitution of the non-renewable woody biomass at each location
Source of data	Biogas User Surveys
Value(s) applied	Scarcity of firewood
Measurement methods and procedures	Annual Biogas User Survey will be conducted on a sample of households. The sample size is determined to achieve 90% confidence interval and a 10% marginof error. During the survey, the type of cooking fuel used by households will be Assessed to demonstrate the scarcity of firewood.
Monitoring frequency	Once in a Year
QA/QC procedures	The number of households in the sample is increased to remedy the possibility of incomplete questionnaires. The surveyors are trained and supervised to minimize any bias.
Purpose of data	To confirm the displacement and substitution of the non-renewable woody biomass
Additional comment	N/A

B.7.2. Sampling plan

Parameters to be monitored

The project monitoring system implemented in the project includes assessment of the performance of biogas units and collection of data to confirm the displacement of NRB.

Following parameters will be monitored:

1. Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent.
2. Digester performance (Operational %) of the biogas digester in particular monitoring period to calculate the Quantity of woody biomass that is substituted or displaced. .
3. Monitoring should confirm the displacement or substitution of the non-renewable biomass at each location (using the indicators on the use of NRB as detailed earlier).

The parameters to be monitored are:

The annual Biogas User Survey (BUS) will be conducted to assess the parameters given above. The survey will be conducted following statistically sound sampling procedure. The Annual Biogas User Survey will be conducted following the Standard for Sampling and Surveys for CDM Project activities and Programme of Activities Ver. 4.0 (EB86, Annex 4). As part of the survey, statistically representative sample of biogas users will be surveyed and in order to

achieve 90% confidence interval and a 10% margin of error requirement for the sampled parameters. Stratified random sampling will be applied in conducting survey. The sample to be surveyed will be drawn randomly from the population of biogas digester distributed in each stratum (i.e. remote hill, hill and terai) spread within the project boundary of the PoA. To make it more representatives, different development regions and the size of the plants will also be considered while drawing the sample. In order to have an unbiased and independent assessment, the survey will be carried out through an independent agency to check the operation/functioning of the biogas units installed as part of the project activity.

1)

The fraction of the Non Renewable Biomass displaced by the project activity has been determined ex-ante in the PDD and has been fixed for the third crediting period. The indicators for the NRB is confirmed through the Biogas User Survey 2017/18 and it is confirmed that firewood scarcity has been increasing since December 1989. The increased scarcity of firewood confirms continued use of NRB, also by non-user households.

The following indicators will be monitored through annual survey to confirm the displacement of NRB use by households, Perceptions of the biogas users on these indicators would be captured through survey and analysed. These indicators include:

a. Trends in distance travelled for firewood gathering or trends in time needed for firewood gathering indicating depletion of resources available
b. Trends in price of firewood indicating demand and scarcity
c. Trends in type of cooking fuel collected that could indicate scarcity of fire wood

At least two of the above indicators should confirm the displacement of non-renewable biomass. The survey will seek to collect the data pertaining to the indicators for monitoring year.

Internal Audit Procedures

The QA/QC includes the following elements:

- Quality inspection: For each plant the digester companies should submit to BSP-NEPAL completion and maintenance reports. Only after the review of the reports, BSP-NEPAL recommends AEPC to release grant payment to the biogas users through the digester companies. BSP-NEPAL conducts quality control of newly constructed plants after the implementation of sales service contracts. They inspect five percent of newly constructed plants and another five percent of digesters after two and three years of plant operation to ensure that After Sales Service has been delivered as required.
- Biogas User's Survey (BUS): The BUS uses a random sample of biogas plant users to measure a wide-range of health, economic, social and environmental indicators. The information obtained from the BUS is used to enable continuous improvement of the program and the technology applied.
- General Evaluations and Assessments: Periodic evaluations are carried out by the donors. Several other assessment such as biogas loan surveys, impact assessments, customer satisfaction surveys, gender assessments, and environmental impact assessments are also conducted. Implementation and operation problems can also be detected through a customer complaint system within BSP.

Data Archiving Procedure

The data archiving procedures followed by the BSP after the completion of the construction of the biogas plant:

1. Update database annually as per subsidy policy and quality standard.
2. Receive and registered forms at Reception, BSP-Nepal submitted by Biogas Companies.
3. Handover forms to Subsidy Administration & Database Unit, BSP-Nepal.
4. Check all the forms with supporting documents, rejected forms will be kept separately in pigeon hole (Company wise).
5. Enter data into Database system, action to rejected forms same as above.
6. Check printed data with original.

7. Publish & compile regular progress report.
8. Verify reports and sign report
9. Dispatch report to AEPC with recommendation for subsidy reimbursement to Biogas Companies.
10. Random sample 5% of data for Quality Control for both New Plant and Plant within guarantee period.
11. QC data entry.
12. Verify data by the controller.
13. Send early warning report to the companies.
14. Regular back up of database.
15. Generate Biogas Performance Index for all companies.

B.7.3. Other elements of monitoring plan

The detailed description of the monitoring plan along with the QA/QC procedures, organization chart, monitoring, reporting and roles and responsibilities have been discussed in Appendix 4 to this PDD.

SECTION C. Start date, crediting period type and duration

C.1. Start date of project activity

01/11/2003
Biogas digester units were installed between 01/11/2003 and 15/06/2004.

C.2. Expected operational lifetime of project activity

21 Years

C.3. Crediting period of project activity

C.3.1. Type of crediting period

Renewable crediting period

C.3.2. Start date of crediting period

01/08/2018 as the second crediting is ended on 31/07/2018. This pertains to the starting date of the third crediting period.

The length of the first crediting period was from 01/08/2004 to 31/07/2011 and the second crediting period was 01/08/2011 to 31/07/2018.

C.3.3. Duration of crediting period

7 years 0 month. This pertains to the length of the third crediting period

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

An Integrated Environmental Impact Assessment (EIA) of biogas digester has been executed by BSP Nepal, including health, socio-economic and gender analysis. The study concluded a net positive benefit from the use of biogas digester on socio-economic and health conditions of the biogas households and on local environment. While no adverse environmental impacts were identified, some concerns were raised with relation to the presence of pathogens in the residual bio-slurry and increased incidence of mosquitoes in the biogas households.

Studies were undertaken to address the pathogen and mosquito concerns. The study on the presence of pathogens in the bio-slurry indicates the presence of some forms of pathogens but confirms the absence of any fatal bacteria like Salmonella typhi and Vibrio Cholarate -01 in all the

samples of the residual bio-slurry. Similarly, the study on mosquito breeding detected no direct link between the mosquito breeding and the biogas plant operation.

D.2. Environmental impact assessment

As per the Environment Protection Act dated 30 January 1997 and Environment Protection Rules dated 26 June 1997, 12 sectors are required to undertake environmental impact assessment studies. It should be noted here that EIA is not a regulatory requirement in Nepal for biogas projects at the individual digester level.

SECTION E. Local stakeholder consultation

E.1. Modalities for local stakeholder consultation

Biogas digesters are sold to households throughout Nepal. Stakeholder consultation in the context of a consumer technology like a biogas digester is automatically built into the sales process. The recognition of the biogas benefits by households is a key to selling of a biogas plant. By paying a considerable amount for its biogas digester (in the range of US$ 148 to 309), the household appreciates the value of the biogas plant. Households will also be required to sign a contract in which they transfer their emission reduction rights and all other rights associated with CDM participation to AEPC in exchange for aftersales support, subsidy and quality control. As part of this process, BSP-Nepal will inform households about the CDM and the international climate change process.

Because of the nature of the biogas installation, no known government regulatory requirement exists concerning the consultation process. Nevertheless, consultations were undertaken with biogas users and non-users in two districts in the Terai (Dhanusha) and Hills (Baglung) regions during 17-20 and 22-25 May, 2005. The consultation process involved detailed household survey of randomly selected biogas users and non-users of the selected Village Development Committees (VDCs) representing the major ethnic/caste groups of the two sample districts, focus group discussion with potential biogas users, and key informants interviews of knowledgeable persons contacted during the visits.

User satisfaction

Since program commencement in 1992-1993 user satisfaction has been monitored via an annual household survey executed by independent external researchers. The results of the end-user surveys show a high satisfaction rate. The above findings agree with several studies carried out in the past by BSP Nepal that revealed the users' satisfaction percentage ranging from 94 to 98%. Among other factors, the users' satisfaction is dependent upon the performance of their units followed by quality of the after sales-services received by them.

As part of market development, the biogas companies informally contact and consult with local NGOs working in the areas related to biogas to help explain the benefits of the bio-gas units to the local population and mobilize their participation in the program. One such local NGO, for example, Resource Management & Rural Empowerment Center (REMREC), works in rural water and sanitation, and cooperates with the local company working in the same area to promote biogas units.

E.2. Summary of comments received

The overall perceptions of the majority of the respondents surveyed about the social, economical, and environmental benefits of the biogas units was positive and they had not perceived any negative social impacts of the BSP at both household and communities levels in both Hills and Terai regions. According to the end-user survey, a majority of the biogas households expressed high satisfaction in the performance of the biogas digester units. Additionally, other studies done on the end-user satisfaction have reached similar conclusions. The Environmental Impact Assessment of BSP-Nepal notes: User satisfaction is the most important factor to judge the successful adoption of the technology. In this regards, the results of the survey revealed that around 95% of the sampled biogas households are satisfied with the performance of their digester

units. The small percentage of the unsatisfied biogas users argued that in some cases, the plant is either too big or in other cases, it is too small (BSP-Nepal, 2002; p.3-3)." It is also noted that particularly women appreciate the benefits of a biogas plant in their house through a smokeless kitchen, reduced drudgery related to fuel wood collection and improved sanitary conditions.

E.3. Consideration of comments received

End-user satisfaction is the ultimate goal of the BSP-Nepal to provide sustainability to the biogas sector. Key to achieving this goal is the continuous consultation with all concerned stakeholders to receive feedback that directly feeds into maintaining and improving the quality of the biogas sector. The quality control program includes a number of mechanisms through which feedback from end-users is sought and fed into the BSP-Nepal to ensure further optimization of the program. They include:

- Quality control monitoring;
- After sales service
- Independent annual end-user survey; and
- Plant verification surveys.

After-sales service

In order to participate in the Program biogas companies are obliged to provide free-after-sales service to the end-users for the first 3 years. This provides end-users with the guarantee that possible construction and material defects in the biogas plant will be repaired. By monitoring the after-sales activities of biogas companies BSP-Nepal gets direct feedback on the quality of systems delivered, which feed into determining the performance of the biogas companies.

Quality control monitoring

BSP-Nepal executes an extensive quality control system of biogas digesters to ensure the interests of households. The result obtained from the quality control monitoring is linked to the payment of bonuses/penalties to the participating biogas companies. Through the system that checks numerous indicators to measure the performance of the company, BSP-Nepal ranks these companies from good to bad. This provides an incentive for these companies to improve the performance of their systems. If a company performs poorly, then the BSP-Nepal provides additional training to aid the company to improve its service quality and strengthen its business operations.

Annual end-user survey

Since 1992-1993 end-user satisfaction has been monitored via an annual household survey executed by independent external researchers. Using the findings and recommendations of the study, BSP-Nepal in conjunction with biogas companies undertake new activities or simply improve the existing ones to strengthen the quality of the biogas sector.

Plant verification studies

Plant verification studies are in-depth studies of a district in which all biogas digester units within the district are interviewed to verify their performance, assess user satisfaction and learn from end-use feedback. Local government authorities in collaboration with BSP-Nepal carry out these studies.

SECTION F. Approval and authorization

Letter of Approval from the Host Party was issued on 20 November 2005 for this project.

Appendix 1. Contact information of project participants

Organization name	Alternative Energy Promotion Centre (AEPC)
Country	Nepal
Address	14237, Khumaltar, Lalitpur
Telephone	00977-1-5529953
Fax	00977-1-5542397
E-mail	Madhusudhan.adhikari@aepc.gov.np
Website	www.aepc.gov.np
Contact person	Mr. Madhusudhan Adhikari, Executive Director

Appendix 2. Affirmation regarding public funding

In addition to the income from carbon finance, the BSP-Nepal will require grant funding to cover the initial investment in the proposed project activity. The cash position of BSP-Nepal indicates a financing gap in the first 10 years of operation. However, BSP-Nepal has secured financial support from KfW (Germany), DGIS (the Netherlands) and AEPC (HMG/N). The sponsors have committed themselves to providing public funding for the proposed project activity for the amounts listed for the 2003-09 period.

KfW: US$ 9.15 million,
DGIS/The Government of the Netherlands: US$ 4.92 million,
HMG/Nepal: US$ 5.61 million.

It should be noted that none of the donors will claim any portion of the emission reductions generated by BSP-Nepal. The AEPC affirms its understanding that the funding for the project activities for the biogas program has not resulted in the diversion of ODA and that this funding is not counted towards the financial obligation of concerned Parties. A letter from Alternative Energy Promotion Center is attached. The confirmation statements by KFW and DGIS on non-diversion of their respective ODAs have been provided.

The CDCF Participants also confirms that any public funding for the purchase of CERS from the Project does not result in a diversion of ODA and is separate from and not counted toward the financial obligation of the concerned Parties.

Appendix 3. Applicability of methodologies and standardized baselines

Estimate of average annual consumption of woody biomass

As per AMS-I.E, version 09, the quantity of woody biomass that is substituted or displaced by the project activity can be calculated as the product of the number of appliances multiplied by the estimate of average annual consumption of woody biomass per biogas user household (tonnes/household/year). This can be derived from historical data or estimated using survey methods. This is calculated based on survey and historic data, such as Biogas User Survey (BUS) 2017/18 for the PA-1.

Confirmation of the Use of Non-Renewable Biomass

Different sources have been used to confirm that NRB is used in Nepal. To determine the actual percentage, national statistics on the supply and demand of firewood have been used. To confirm

that NRB continues to be used, the project participants conducted a survey to check whether the firewood replaced by the digesters is subject to the trends defined in AMS-I.E.: increasing amount of time needed or distance travelled for firewood gathering, increasing firewood prices or changes in the type of firewood used. The indicators selected to monitor the continued displacement of NRB in the project are:

1) increase in time needed to gather firewood or increase in distance travelled to gather firewood
2) Increasing trend in fuel wood price.

The Biogas Users Survey 2017/18 which was confirmed in the context of Project Activity-1 reveals the following:

- Increase in time and distance travelled to gather firewood. The time required to reach the forest, collect one bundle of fire wood and return back now is 37 minutes; 145 minutes and 40 minutes respectively., whereas before seventeen years it was 34 minutes, 121 minutes and 38 minutes respectively. Likewise, 28 years before; it was 32 minutes 110 minutes and 35 minutes respectively. This indicate that the sourcing biomass from forest over the years have become even more difficult.

- Increase in fuel wood price: The results reveal that the average market price of one bhari[13] of fuel wood in 1989 was NPR 36 which rose to NPR 485/bhari in 2018. Contemporary price of fuel wood is more than 2.5 times the price in 2000 when the price was NPR 176/bhari

The trend reported in the above survey is also confirmed by another study by Jean-Marie Baland[14], where forest in the Nepalese Himalayas is reported to be degrading at an alarming rate, which could have serious environmental and economic consequences. The following are some of the findings of this study:

- Nepal's forest cover declined at an annual rate of 1.8% per year between 1980 and 2000.
- Forest degradation leads to increased fuel scarcity. "The time needed to collect firewood has increased 60% over the past quarter century, while collections per household have decreased by 40%."
- Deforestation "is partly irreversible as fertile topsoil is being washed out by soil erosion in deforested areas."
- The report also concludes that collection time is a good indicator of forest degradation since "A major impact of forest degradation for the villagers is the resulting increase in collection time."

A report by the Ministry of Population and Environment[15]confirms deforestation trends in Nepal and connects them with firewood use:

- "The forest area has declined from 45 per cent in 1966 to 29 per cent by the end of the 20th century. The quality of forest has also declined as the shrub land area has doubled from 4.8 per cent in mid-1980s to 10.6 per cent in mid-1990s. The annual deforestation is estimated at 1.7 per cent with 2.3 per cent in the Hill, and 1.3 percent in the Terai."
- "In general, forest depletion is increasing due to firewood collection, cattle grazing, and conversion of forests to agricultural land."
- "Although firewood consumption is slightly decreasing over the years, forest depletion and deforestation is increasing as a majority of the people depend on it."

[13] 1 Bhari approximately contains 35 kg

[14] Jean Marie Baland, "The Environmental Impact of Poverty: Evidence from Firewood Collection in Rural Nepal",Boston University - The Institute for Economic Development Working Papers Series, 30 June 2007.

[15] His Majesty's Government of Nepal Ministry of Population and Environment, NEPAL National Action Programme on Land Degradation and Desertification in the context of United Nations Convention to Combat Desertification (UNCCD), Kathmandu, April 2004

The price of firewood is not used as indicator for firewood scarcity since very little firewood used is bought from the market.[16] The main source of firewood is government forests controlled by the Ministry of Forest and Soil Conservation which allocates forest areas to the Timber Corporation of Nepal (TCN). Since supply from TCN is insufficient, unofficial firewood extraction for self-consumption and trade remain substantial, also in government forests.

Fire wood used by households in the baseline scenario are predominantly non-renewable. Table below provides an overview of the firewood consumption for cooking in the baseline scenario.

Table: Energy use for cooking before implementation of the digester and stove.[17]

	Terai	Hills	Remote Hills
Fire Wood (tons/year/household)	4.96	5.18	5.04

The above data clearly indicates that firewood is the predominant source of cooking energy for households.

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

N/A

Appendix 5. Further background information on monitoring plan

Sampling Plan

As per the Standard for Sampling and Surveys for CDM Project activities and Programme of Activities Ver. 4.0 (EB86, Annex 4, the sampling plan for this activity is as follows:

(a) Sample Design

Objectives and Reliability Requirements

The sampling objective is to obtain a reliable estimate of the key variables used in the estimation of emission reductions. According to AMS-I.E. Version 9, the parameters chosen by project participants for monitoring are:

- Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent.
- The percentage of digesters operational in a year from among the digesters implemented to calculate By This will be done through a survey of a sample appliances once every year to ensure that they are operating or replaced by an equivalent in service appliance.
- The confirmation of the displacement or substitution of the non-renewable woody biomass by households. This has to be captured through the measurement of two of the following parameters: a) Trends in distance travelled for firewood gathering or trends in time needed for firewood gathering indicating depletion of resources available, b) Trends in price of firewood indicating demand and scarcity, c) Trends in type of cooking fuel collected that could indicate scarcity of fire wood.

[16] Government of Nepal Water and Energy Commission Secretariat, Energy Synopsis Report: Nepal 2006 Report No: 7, Seq. No. 489, June, 2006, Kathmandu, page 15;

[17] Annual Biogas Users' Survey 2017/2018 for Biogas Support Program – Nepal (BSP - Nepal) Activity – I

Sampling approach is proposed to be implemented to measure the above parameters. For representative sampling methods, AMS-I.E, Version 09 requires a 90% confidence interval and a 10% margin of error for annual inspection, which will be adopted for the sample design.

Moreover, the percentage of digesters operational and the average annual consumption of woody biomass per households is the most important parameter that directly affects the emission calculation and that can only be estimated from field survey. Therefore, those parameter will be used to calculate the sample size while the same sample will be used to determine all above parameters to confirm the continuous use of the non-renewable biomass.

Target population

The target population is the households using biogas digester units spread over in Terai, hill and Remote Hill of Nepal where a total of 9,692 biogas digesters units were installed under the Biogas Support Program - Nepal (BSP-Nepal) Activity-1. The population is distributed over 57 districts across Nepal.

Sampling method

The stratified random sampling method will be used to take into account different ecological zones (Terai, Hills and Remote Hills) as strata. To make it more representatives, districts and villages and different biogas plants sizes will also be considered while samples picked up randomly from each category. The sample size is distributed proportionally to account for the number of biogas units installed per districts and sizes. This approach allows to derive a value that capture difference between locations and households.

Sampling size

The sample size determination is applied to the entire population of users of biogas plants (households). The total population is used for the sampling size calculation is 9,692 biogas plants. As required in AMS-I.E, Version 09, for annual survey, the sample has to be determined with 90/10 confidence/precision level.

Proportional Parameter (Biogas Performance)

The percentage of digesters operational is a proportion value for the categorical data requiring two possible answers (YES or NO). The minimum sample size is calculated using appendix 1 para 24 of Standard for Sampling and Surveys for CDM Project activities and Programme of Activities Ver. 4.0 (EB86, Annex 4).

$$n \geq \frac{1.645^2 NV}{(N-1)\times 0.1^2 + 1.645^2 V}$$

Where:
N = Total Population (9692)
n = sample size

$V = \frac{SD^2}{\bar{p}^2} = \frac{\text{overall variance}}{\bar{p}^2}$ and $\bar{p}$ is the overall proportion.

$$SD^2 = \frac{(g_a \times p_a(1-p_a)) + p_b(g_b \times (1-p_b)) + (g_c \times p_c(1-p_c)) + \cdots + (g_k \times p_k(1-p_k))}{N}$$

and

$$\bar{p} = \frac{(g_a \times p_a) + (g_b \times p_b) + (g_c \times p_c) + \ldots + (g_k \times p_k)}{N}$$

Where,
g_i is the size of the i_{th} group and p_i is the expected proportion of i_{th} group

The sample in each strata then will be calculated as below:

$$n_i = \frac{g_i}{N} \times n$$

To calculate the sample size, following parameters are considered for this project activities.

Particulars	Symbol	Value	Remarks
Total Number of Population	N	9692	Database
Number of Biogas in Terai	g_t	5105	Database
Expected operational Proportion of Biogas in Terai	p_t	0.86	As per Biogas User Survey 2017/18 for the project activity
Number of Biogas in Hill	g_h	4517	Database
Expected operational Proportion of Biogas in Hill	p_h	0.69	As per Biogas User Survey 2017/18 for the project activity
Number of Biogas in Remote Hill	g_{rh}	70	Database
Expected operational Proportion of Biogas in Remote Hill	p_{rh}	0	As per Biogas User Survey 2017/18 for the project activity

The sample size is calculated as 72. In order to anticipate any low response rate and answers bias, at least 10% oversampling has to be done with minimum sample of 80 is retained for the monitoring of operational status of the Biogas digesters.
For the first monitoring, the values as described above are applied. For the following monitoring periods, the estimates shall be adjusted taken the results of the previous monitoring period(s) into account.

The project participants can use a sample size larger than the minimum calculated depending on budget availability. The actual sample size will be established for each annual biogas users survey.

Mean value parameter (Average annual consumption of woody biomass by pre-project device during project activity)

The minimum sample size for the monitoring parameters is determined using the equation given in para 60 of appendix 1, EB 86 Annex 4, Guidelines for Sampling and Surveys for CDM Project activities and Programme of Activities Ver. 4.0.

$$n \geq \frac{1.645^2 \, NV}{(N-1) \times 0.1^2 + 1.645^2 \, V}$$

Where,

$V = (SD/Mean)^2$
n = Sample Size
N = Total number of Population
SD = Overall standard deviation
Mean = Overall mean for the average annual woody biomass consumption by pre-project device during project activity
1.645 = Represent 90% confidence required

0.1 = Represent the 10% relative precision

To calculate the sample size, following parameters are considered for this project activities.

Particulars	Symbol	Value	Remarks
Total Number of Population	N	9692	Database
Overall standard deviation	SD	0.28	As per Biogas User Survey 2017/18 for the project activity
Overall mean	Mean	0.55	As per Biogas User Survey 2017/18 for the project activity

The sample size is calculated as 69. Since minimum sample required for the proportional parameter is retained as 80, same samples will be taken for the mean value parameters conservatively. So, for the monitoring of this activity, minimum 80 samples will be retained to monitor all parameters.

Sampling frame

The sampling frame is the complete listing of 9,692 family size biogas plants installed in 57 districts across Nepal. The districts covered under the project activity will be grouped into three strata as: i) Remote/High Hills, ii) Hills and iii) Terai regions.

A stratified random sampling will be used ensuring development regions and district-wise distribution of the samples for better representation.

Quality Assurance/Quality Control:

A survey questionnaire will be prepared to seek responses of operating status (yes or no) of biogas digester units, estimate the average woody biomass consumption per household during project activities and to assess the displacement of NRB by biogas digester user households.

The project entity will ensure that all 80 questionnaires are filled. To remedy the incomplete questionnaires, additional households will be drawn randomly until the required number (80) is met at per the sample size determined.

Moreover, after completing a day's work the enumerators will check each questionnaire in the evening and correct any mistakes or inconsistencies immediately the next day by revisiting the household in question and verifying the information.

Analysis:

The data collected will be compiled in Excel sheets and/or other software and analyzed to derive the percentage of digesters in operation, average annual consumption of woody biomass during project activity and displacement or substitution of NRB by households. The final results are arranged per ecological zones. The weighted average of the values are calculated and use for emission reductions calculation.

Emission reductions are directly proportional to the number of appliances (biogas digester units in case of the project) that are operating and displacement or the substitution of NRB.

(c) Implementation

The following activities consist in the implementation plan:

- Preparation of survey questionnaires. The survey questionnaire will be prepared by the project entity or its consultant.
- Recruitment and training of enumerators. For the purpose of the survey, enumerators will be selected based upon their experiences in previous biogas users' survey and their involvement in the field of social survey. As in previous BUS, orientation-days training will be conducted for the enumerators prior to field mobilization.

- Pretesting of the questionnaire. The initially finalized questionnaires will be used during the pre-test exercise. Based on the outcome of pre-test, the questionnaires will be further improved and finalized before the deployment of the survey
- Supervision of the survey. The supervision team will consists of supervisors and professional members of the survey team. The Supervisors will visit the assigned districts to facilitate the quality control of the survey work in their respective districts. Moreover, the Senior Member of the Survey Team will also visit some of the districts to cross check the field survey process conducted by the Enumerators and Supervisors.

ORGANISATIONAL STRUCTURE

BSP is supported by the Nepalese government and international donors including the German Development Bank (KfW) and the Netherlands Development Organisation (SNV funded by DGIS). The responsibilities of different organizations are listed below:

Alternative Energy Promotion Centre- Operation and Management Plan

- The AEPC is responsible for overall coordination and the execution of the BSP. The AEPC provides feedbacks to GoN for policy formulation and executes the policies.
- The AEPC is responsible for overall monitoring and evaluation together with SNV/N and other development partners). This also includes endorsing new modalities e.g. the modality to be developed to target the poor.
- The AEPC is responsible for carrying out Annual Biogas Users' Survey that is also in line withthe requirements of the CDM. The survey would report the performance of the digesters as wellas perceptions of biogas users on the various indicators that confirm the displacement of NRB.
- The AEPC administrates subsidy and biogas credit fund as per developed guidelines and procedures and also explores possibilities to flow credit fund through other institutions beside the MFIs.
- The AEPC is responsible for coordination with national level financial institutions (e.g. ADB/L,) and other government agencies relevant for promotion of biogas technology.
- The AEPC advocates and promotes biogas programme at macro level.

Netherlands Development Organization in Nepal

- The SNV/N provides advisory services to organizations of the biogas sector. The advisory services will be provided on a demand-driven basis from the partners in technical; promotion; marketing; poverty linkage; gender and social inclusion; capacity strengthening, etc.
- The SNV/N administrates financial support for the BSP Phase-IV to BSP-NEPAL based on approved plans and budgets, on behalf of the DGIS.
- The SNV/N is responsible for overall monitoring and evaluation together with the AEPC and other development partners). This also includes endorsing new modalities e.g. the modality to be developed to target the poor.

Kreditanstalt fur Wiederaufbau of Germany

- KfW continues to provide financial support for subsidy to households constructing biogas plants under the BSP Phase-IV.
- KfW is responsible for overall programme evaluation together with the AEPC and other development partners. This also includes endorsing new modalities e.g. the modality to be developed to target the poor.

BSP-Nepal

- The BSP-NEPAL as an implementing agency facilitates, backstops, promotes as well as regulates to develop the sector.
- The BSP-NEPAL with the involvement of the NBPA and others is responsible to implement BSP-IV as per agreement signed among the AEPC, SNV/N, and BSP-NEPAL.

- The BSP-NEPAL is responsible for R&D for optimization of biogas plant operation and new designs.
- The BSP-NEPAL facilitates and provides technical assistance to the NBPA and BCs.
- The BSP-NEPAL processes the subsidy applications and recommends to AEPC for subsidy reimbursement to the users through the BCs.
- The BSP-NEPAL also assists the AEPC in finding appropriate modalities or organizations for credit fund flow.
- The BSP-NEPAL is responsible for quality control and regular monitoring of the subsidized biogas plants, including company qualification, performance evaluation, grading, penalty, bonus, disqualification as well as for provision of after-sales services and warrantee.
- The BSP-NEPAL together with the NBPA (and the AEPC, when participation fee is used) develops skill enhancement package and implements it for BCs.
- The BSP-NEPAL co-ordinates with other development partners for the biogas promotion at macro and meso levels.
- The BSP-NEPAL acts as a secretariat for BCC and CST.
- The BSP-NEPAL is also responsible for the overall market development of the sector through various promotion activities.
- BSP-NEPAL is responsible to present the any new modalities to be developed under the BSP Phase-IV for endorsement of the AEPC, SNV/N and KfW.
- The NBPA will promote interests of the BCs and self-regulate them through the code of conduct and other appropriate mechanisms. When necessary, NBPA seeks help from BSP-NEPAL and others for this purpose.
- The NBPA is responsible to arrange and supply biogas plant materials (kits), especially to BCs that have low business volume.
- The NBPA together with BSP-NEPAL and BCs coordinates with development partners at micro and meso levels.

Biogas Companies

- BCs are responsible to disseminate information on the programme, its benefits, the subsidy, credit, etc. verbally or distributing the materials from BSP-NEPAL and other partners.
- BCs are responsible to promote market and construct quality biogas plants.
- BCs are responsible to handover the Users' Manual and other information materials from BSP NEPAL and train the users on operation and maintenance of the plants.
- BCs are responsible for training users on proper use of slurry, composting and use of it.
- BCs are responsible to complete documentation required for processing of subsidy, and for release of the after-sales service guarantee money and submit them to BSP-NEPAL in a timely manner.
- BCs are responsible to cooperate and accompany BSP-NEPAL personnel in the field for quality control and other verification purposes.
- BCs regularly visit households and deliver the promised after-sales service and other services fully respecting the promised guarantee. They continue providing these services perpetually even after expire of the guarantee period.
- BCs are responsible to expand their product lines by constructing plants within and outside the subsidy programme for improved commercialization of the biogas industry.
- The BCs facilitate and coordinate with banks, MFIs and other CBOs/NGOs to ease credit flow to beneficiaries.
- BCs are responsible for other activities that help to promote the technology by linking it with other rural development agencies at the local level to better benefit the users improving their livelihood.

Appendix 6. Summary report of comments received from local stakeholders

N/A

Appendix 7. Summary of post-registration changes

N/A

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Document information

Version	*Date*	*Description*
10.1	28 June 2017	Revision to make editorial improvement.
10.0	7 June 2017	Revision to: • Improve consistency with the "CDM project standard for project activities" and with the PoA-DD and CPA-DD forms; • Make editorial improvement.
09.0	24 May 2017	Revision to: • Ensure consistency with the "CDM project standard for project activities" (CDM-EB93-A04-STAN) (version 01.0); • Incorporate the "Project design document form for small-scale CDM project activities" (CDM-SSC-PDD-FORM); • Make editorial improvement.
08.0	22 July 2016	EB 90, Annex 1 Revision to include provisions related to automatically additional project activities.
07.0	15 April 2016	Revision to ensure consistency with the "Standard: Applicability of sectoral scopes" (CDM-EB88-A04-STAN) (version 01.0).
06.0	9 March 2015	Revision to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Make editorial improvement.

Version	*Date*	*Description*
05.0	25 June 2014	Revision to: • Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and Appendix 1; • Change the reference number from F-CDM-PDD to CDM-PDD-FORM; • Make editorial improvement.
04.1	11 April 2012	Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b.
04.0	13 March 2012	Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8).
03.0	26 July 2006	EB 25, Annex 15
02.0	14 June 2004	EB 14, Annex 06b
01.0	03 August 2002	EB 05, Paragraph 12 Initial adoption.

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