



# PROJECT IDENTIFICATION FORM (PIF)

PROJECT TYPE: Medium-sized Project

TYPE OF TRUST FUND: GEF Trust Fund

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## PART I: PROJECT INFORMATION

Project Title:	Reduction of GHG emission through promotion of commercial biogas plants		
Country(ies):	Kingdom of Cambodia	GEF Project ID: <sup>1</sup>	5421
GEF Agency(ies):	UNIDO	GEF Agency Project ID:	120118
Other Executing Partner(s):	Ministry of Environment (MoE) and Ministry of Agriculture, Forestry and Fisheries (MAFF)	Submission Date:	04/30/2013
		Resubmission Date:	09/27/2013
		Resubmission Date:	10/31/2013
GEF Focal Area (s):	Climate Change	Project Duration (Months)	48
Name of parent program (if applicable):		Project Agency Fee (\$):	142,547
<ul style="list-style-type: none"> <li>• For SFM/REDD+ <input type="checkbox"/></li> <li>• For SGP <input type="checkbox"/></li> <li>• For PPP <input type="checkbox"/></li> </ul>			

### A. INDICATIVE FOCAL AREA STRATEGY FRAMEWORK<sup>2</sup>:

Focal Area Objectives	Trust Fund	Indicative Grant Amount (\$)	Indicative Co-financing (\$)
CCM – 3 Promote investment in renewable energy technologies	GEFTF	1,500,499	8,230,000
Total Project Cost		1,500,499	8,230,000

### B. INDICATIVE PROJECT DESCRIPTION SUMMARY

Project Objective: To promote investments in biogas based rural electricity enterprises (REE) for increasing rural electrification						
Project Component	Grant Type <sup>3</sup>	Expected Outcomes	Expected Outputs	Trust Fund	Indicative Grant Amount (\$)	Indicative Cofinancing (\$)
1. Creating awareness on climate change (CC) and building capacity in commercial biogas based mini-grids	TA	1. Global CC addressed and contributed. 2. Human and institutional capacity available on commercial biogas based mini-grids	1.1. Awareness on CC improved among the targeted stakeholders 1.2. An information centre for commercial biogas power plants established 1.3. Capacity developed among policy makers, project developers and financial institutions on commercial biogas based mini-grids	GEFTF	144,090	2,250,000
2. Creating enabling environment for investments in commercial biogas technology	TA	Established financing facility and increased involvement of farm owners and financing institutions in commercial biogas technology	2.1. Revolving fund established for commercial biogas based electricity generation	GEFTF	200,000	2,000,000

<sup>1</sup> Project ID number will be assigned by GEFSEC.

<sup>2</sup> Refer to the reference attached on the [Focal Area Results and LDCF/SCCF Framework](#) when completing Table A.

<sup>3</sup> TA includes capacity building, and research and development.

3. Demonstrating biogas based mini-grid technologies in commercial farms	INV	Increased biogas based rural electricity enterprises (REEs)	3.1. One MW of biogas based mini-grids established in 3-5 animal farms	GEFTF	1,000,000	3,000,000
4. Monitoring and evaluation (M&E)	TA	Effectiveness of the outputs assessed, corrective actions taken and experience documented	4.1. Mid-term M & E report prepared. 4.2. End of project M & E report prepared	GEFTF	20,000	130,000
Subtotal					1,364,090	7,380,000
Project Management Cost (PMC) <sup>4</sup>				GEFTF	136,409	850,000
Total Project Cost					1,500,499	8,230,000

**C. INDICATIVE CO-FINANCING FOR THE PROJECT BY SOURCE AND BY NAME IF AVAILABLE, (\$)**

Sources of Cofinancing	Name of Cofinancier	Type of Cofinancing	Amount (\$)
Kingdom of Cambodia	Ministry of Environment	In-kind	80,000
Kingdom of Cambodia	Ministry of Agriculture, Forestry and Fisheries	In-kind	3,000,000
Private Sector	Unknown at this stage	Grant	3,000,000
Other Multilateral Agency	Agence Française de Développement (AFD)	Grant	2,000,000
GEF Agency	UNIDO	Grant	60,000
GEF Agency	UNIDO	In-kind	90,000
<b>Total Cofinancing</b>			8,230,000

**D. INDICATIVE TRUST FUND RESOURCES (\$) REQUESTED BY AGENCY, FOCAL AREA AND COUNTRY<sup>5</sup>**

GEF Agency	Type of Trust Fund	Focal Area	Country Name/Global	Grant Amount (\$ (a))	Agency Fee (\$ (b) <sup>6</sup> )	Total (\$) c=a+b
(select)	(select)	(select)				0
<b>Total Grant Resources</b>				0	0	0

**E. PROJECT PREPARATION GRANT (PPG)<sup>7</sup>**

Please check on the appropriate box for PPG as needed for the project according to the GEF Project Grant:

	<u>Amount Requested (\$)</u>	<u>Agency Fee for PPG (\$)<sup>8</sup></u>
• No PPG required.	_____	_____
• (up to) \$50k for projects up to & including \$1 million	_____	_____
• (up to) \$100k for projects up to & including \$3 million	50,000	4,750
• (up to) \$150k for projects up to & including \$6 million	_____	_____
• (up to) \$200k for projects up to & including \$10 million	_____	_____
• (up to) \$300k for projects above \$10 million	_____	_____

<sup>4</sup> To be calculated as percent of subtotal.

<sup>5</sup> In case of a single focal area, single country, single GEF Agency project, and single trust fund project, no need to provide information for this table. PMC amount from Table B should be included proportionately to the focal area amount in this table.

<sup>6</sup> Indicate fees related to this project.

<sup>7</sup> On an exceptional basis, PPG amount may differ upon detailed discussion and justification with the GEFSEC.

<sup>8</sup> PPG fee percentage follows the percentage of the GEF Project Grant amount requested.

**PPG AMOUNT REQUESTED BY AGENCY(IES), FOCAL AREA(S) AND COUNTRY(IES) FOR MFA AND/OR MTF PROJECT ONLY**

Trust Fund	GEF Agency	Focal Area	Country Name / Global	(in \$)		
				PPG (a)	Agency Fee (b)	Total c = a + b
						0
<b>Total PPG Amount</b>				<b>0</b>	<b>0</b>	<b>0</b>

MFA: Multi-focal area projects; MTF: Multi-Trust Fund projects.

## **PART II: PROJECT JUSTIFICATION**<sup>9</sup>

### **A. Project Overview**

**A.1. Project Description.** Briefly describe the project, including ; 1) the global environmental problems, root causes and barriers that need to be addressed; 2) the baseline scenario and any associated baseline projects, 3) the proposed alternative scenario, with a brief description of expected outcomes and components of the project, 4) incremental cost reasoning and expected contributions from the baseline, the GEFTF, LDCF/SCCF and co-financing; 5) global environmental benefits (GEFTF, NPIF) and adaptation benefits (LDCF/SCCF); 6) innovativeness, sustainability and potential for scaling up

### **Global Environmental Problem, root causes and barriers**

Cambodia is a country with one of the lowest electrification rates in Asia, owing to its poor investments in electricity sector and inadequate exploitation of available renewable energy (RE). Only 6% of the rural population is connected to the grid. Around 55% of the rural population use automobile batteries for their electricity needs, 3% use their own individual power generating units and the remaining 36% has no access to electricity<sup>10</sup>. In the absence of grid electricity provision, the small independent private entrepreneurs, i.e., Rural Electricity Enterprises (REEs) supply electricity to the nearby areas using diesel generators to satisfy the rural electricity demand.

Cambodia is highly vulnerable to the impacts of climate change and variability, because of the high dependence of its economy on climate-sensitive sectors. The country's agricultural production system is dependent on the annual flooding and receding of Tonle Sap Great Lake and is therefore, particularly sensitive to potential changes in local climate and monsoon regimes<sup>11</sup>. Usage of diesel generators further increases the vulnerability to CC.

Biogas based mini-grid holds greater promise for Cambodia in addressing CC and providing access to energy for all its population. The rural electricity situation in the country can be significantly improved if commercial biogas power plants are implemented. UNIDO conducted a rapid potential assessment study on developing bio-digester in commercial animal farms in the year 2011, in the regions of Phnom Penh, Kampong Speu, Kampot, Kandal, and Takeo. The study identified the potential of implementing commercial biogas power plants/mini-grids in these farms.

However, such implementation are hampered by barriers such as: a) lack of awareness and confidence among farm owners to invest in commercial biogas power plants, b) inadequate human and institutional capacity in planning, investigating, designing, constructing, operating, maintaining and managing commercial biogas power plants, c) lack of access to financial sources and financial incentives, d) lack of appropriate technology for commercial biogas power plants and e) inadequate general awareness on CC and GHG mitigation options.

### **Baseline scenario and associated baseline project**

In Cambodia, the Government had implemented a National Bio-digester programme (phase 1) during 2005 to 2012. This programme promoted bio-digesters in the domestic sector. As the result of its success, "domestic national bio-digester program (NBP) phase – II (2013 to 2016)" has been initiated to extend the domestic biogas programme to more provinces in the country. The overall objective of the NBP is the dissemination of domestic bio-digesters as an indigenous, sustainable energy source in Cambodia.

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<sup>9</sup> Part II should not be longer than 5 pages.

<sup>10</sup> [www.worldbank.org/kh](http://www.worldbank.org/kh)

<sup>11</sup> Climate Change Impacts and Vulnerability, UNDP Cambodia, August 2012;

[http://www.nlcs.org.kh/Document/Other\\_Document/Climate%20Change%20Presentation%20in%20Siem%20Reap%2001August2012.pdf](http://www.nlcs.org.kh/Document/Other_Document/Climate%20Change%20Presentation%20in%20Siem%20Reap%2001August2012.pdf)

The proposed GEF project intends to add medium and large scale farms to this baseline project. Biogas based electricity generation potential in medium and large scale animal farms, especially the piggeries with 1,000 to 10,000 animals, has not been exploited and was not envisaged in NBP 1 & 2. The current practice of dumping or stockpiling the wastes from these farms will continue to emit methane to the atmosphere. The quantity of methane emission will be looked into during PPG phase. The role of private sector, which is very crucial for investments in increasing the energy supply from renewable sources, has been very minimal.

UNIDO's assessment study in animal farms during 2011 identified that there is a high interest among private sector/commercial farms to; (a) invest in biogas technology, b) learn the technical know-how on construction, operation and maintenance of efficient biogas plant, c) learn operation/maintenance of biogas plants and d) acquire knowledge on converting digested sludge/slurry into organic fertilizer.

The electricity tariff rates prevailing in Cambodia are as follows<sup>12</sup>:

- Grid connected in Phnom Penh: 0.18 USD/kWh for households, 0.19 USD/kWh for businesses
- Other grid-connected towns and urban areas: 0.25 - 0.40 USD/kWh
- Rural areas (mostly diesel generators): 0.50 - 1 USD/kWh
- Battery (car batteries) charging stations (diesel - to be found in 35% of rural villages): up to 4 USD/kWh

As compared to the above, biogas electricity would be much cheaper and would be affordable to the rural communities. Preliminary calculation shows that biogas electricity generation cost would be around 0.2 USD/kWh. This is 2-4 times cheaper than diesel electricity<sup>13</sup>.

During the *UNIDO rapid potential assessment study* in animal farms conducted in the year 2011, it was noticed that rural people are ready to pay for quality energy, if it is cheaper with less expensive connection fee.

In the absence of the proposed GEF project, very limited efforts would be taken to address the existing issues. A holistic approach and country wide efforts for improving the commercial biogas based mini-grid sector would never take place.

#### Note on ongoing GEF-UNIDO project

The major objective of the project "Climate Change related Technology Transfer for Cambodia: Using Agricultural Residue Biomass for Sustainable Energy Solutions" is as follows:

*To bring about sustained transfer of efficient, cost effective and environmentally friendly (low carbon) agro waste biomass-fuelled energy systems to replace fossil-fuel powered generators and boilers for power generation and thermal energy applications.*

From the above, it is clear, that the project focuses mainly on the biomass technologies for power and thermal energy applications. Demonstration, capacity building, institutional strengthening, up scaling of the technology, as proposed in the project, focuses only on biomass technology.

The above project also includes a component on "Policies, regulations and mechanism to promote sustainable renewable energy generation" which aims at establishing the policies, legal and regulatory framework for the sustainable promotion and support of renewable energy generation.

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<sup>12</sup> [https://energypedia.info/wiki/Cambodia\\_Country\\_Situation](https://energypedia.info/wiki/Cambodia_Country_Situation)

<sup>13</sup> For diesel electricity, the generation cost was found to be 0.64 USD/kWh. This value varies with the efficiency of the diesel generator. Energy generation cost is calculated considering both investment and operation & maintenance cost of both the power plant (biogas or diesel) and mini-grid. Detailed economics on energy production cost would be given at CEO Endorsement stage.

As compared to this, the proposed GEF-UNIDO project will focus only on the commercial biogas technology promotion and does not involve any activities related to biomass power generation. The two proposals focus on totally different technologies. The proposed project will however benefit from the policy component of the on-going UNIDO project.

### **Proposed alternative scenario**

The activities under the project will augment the usage of biogas technology for electricity generation in the commercial animal farms in Cambodia. This project will use GEF resources to finance incremental costs of demonstrating and promoting biogas-based mini-grid projects as financially viable and effective mechanism to achieve rural electrification (by displacing diesel generators) to private sector investment sources. The GEF project would hopefully result in removal of the key barriers that currently limit the use of biogas-based commercial electricity generation for rural electrification, thereby resulting in a reduction of GHG emissions.

#### **Component 1: Creating awareness on CC and building capacity in commercial biogas based mini-grids**

Under this component, various campaigns and workshops will be conducted to raise awareness among the key decision makers including MoE, MAFF, Non-Government Organizations (NGOs) and other institutions interested in CC and GHG mitigation measures. Promotion materials will be developed, tested and subsequently used for awareness raising purpose.

At present, local human and institutional technical capacity in medium/large scale commercial biogas plants does not exist in Cambodia. To address this barrier, under this component, an information centre for commercial biogas power plants will be established at a university or a technical institution (to be identified during the PPG stage). This centre will provide continuous technical support on design, development, operation and maintenance of commercial biogas power plants even beyond the project duration. Moreover, basic technical capacity on domestic biogas plant exists in Cambodia. This capacity can be built on to the medium/large scale commercial biogas plant requirements.

The policy makers and interested project developers will be educated and efforts will be taken to help them gain confidence in the technology. They will also be equipped with necessary technical capacity for supporting, developing and implementing commercial biogas projects. Personnel from banks and financing institutions will be trained in assessing these projects. Local engineering and O&M companies will be trained to facilitate sustainable operation and maintenance of the demonstration and replication projects. Guidebooks on commercial biogas power plant based mini-grid development will be prepared.

The capacity development at the proposed information centre would be sustained through the following activities:

- A nominal fee would be charged for the training activities in the centre. This amount would be used to manage and maintain the activities of the centre.
- The existing staff members of the institution would be managing the information centre and hence, there would be no additional man-power cost

Modalities for sustainable operation of the centre will be further elaborated during the PPG phase.

#### **Component 2: Creating enabling environment for investments in commercial biogas technology**

Through this component, conducive environment for promoting investments in biogas based mini-grids will be created.

Two million USD will be considered for the financing facility. This amount is decided based on the finances available from the co-financiers. Agence Française de Développement (AFD) has agreed on a grant of USD 2 million for this purpose.

AFD is a financial institution and the main implementing agency for France's official development assistance to the developing countries and overseas territories.

A revolving fund for commercial biogas plants will be created under Ministry of Environment (MoE) with the involvement of Agence Française de Développement (AFD). The executing bank for the revolving fund may include AFD (with a branch office in Cambodia) and other local financial institutions such as Canadia Bank, ANZ Royal Bank, etc.

During the PPG phase, as an immediate activity, appropriate local executing bank will be identified so as to involve them in the project preparations from the beginning itself.

Being a financial institution, AFD itself has necessary capability to deal with the revolving fund. Also, the local banks, to be involved, will be chosen based on their prior experiences and capability in dealing with the revolving funds. Already banks like Canadia Bank, ANZ Royal Bank, etc. have prior experience in handling such schemes<sup>14</sup>.

Revolving fund would provide soft loan at lower interest rate (when compared to that of the existing commercial bank loan interest in Cambodia) so as to cover the operational expenses, agency fees (for the executing bank), etc. This design would ensure financial sustainability for many years even after the project duration. This financial sustainability will be given in detail in the CEO Endorsement document.

The exact details of the revolving fund, its operating modalities and procedures would be described in the CEO Endorsement document.

This revolving loan facility will be accessible to the identified demonstration pilots. They will have a possibility to access these loan facility funds so as to enable them reach financial closure. They can be the first beneficiaries of the proposed revolving loan facility and thus providing the lessons for its applicability and improvements.

### Component 3: Demonstrating biogas and mini-grid technologies in commercial farms

Under this component, mini-grid demonstration projects of 1 MW cumulative capacity, based on biogas technology will be established with private sector investments in commercial medium and large scale farms. These power plants will construct their own mini-grids for captive usage and electricity supply to the nearby communities and thereby will function as REEs.

At present, there is no separate policy for mini-grid connection. However, procedures do exist for providing institutional and regulatory framework for mini-grids. There is a "*Procedure for Issuing, Revising, Suspending, Revoking or Denying Licenses for Providing Electrical Power Services*" under Electricity Law of the Kingdom of Cambodia, which is the institutional and regulatory framework for mini-grids. Electricity Authority of Cambodia (EAC), which is a body under the Council of Ministers, is responsible for monitoring licensed REEs, including those that operate mini-grids. In addition, according to electricity law of Cambodia, interested individuals are encouraged to establish their own private electricity supply services<sup>15</sup>. As of now, UNIDO does not envisage any barriers in this domain. Demonstration projects will use the existing regulatory and institutional framework.

UNIDO conducted a rapid potential assessment study during the year 2011 and identified few potential

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<sup>14</sup> Please refer to <http://www.anzroyal.com/en/Small-Business/Products-Services/Term-Financing/> and <http://www.canadiabank.com.kh/sme.aspx>

<sup>15</sup> [http://www.eac.gov.kh/license\\_fee.php](http://www.eac.gov.kh/license_fee.php)

sites including BVB investment cop (187.5 kW), Mr. Hok Heang Farm (20 kW), 7NG Group Co. Ltd. (70 kW), Soma Group Co. Ltd. (120 kW), Rattanak Visal Investment Cop (21 kW) and Smart Mekong (50 kW)<sup>16</sup>. As of now, some of the farms could have been expanded and hence, the power generation potential sites mentioned above are only an indicative.

The locations considered as demonstration sites are the locations where electricity is not available at present. In rural Cambodia, grid is mainly available on the main road. The probable demonstration sites are at around 10-30 km from the main road. Even in the area where grid is available, rural people find it less affordable due to the high one time down payment for grid connection.

Details on the surrounding villages and the status of the grid availability in the potential demonstration sites is given in the following table<sup>17</sup>:

**Table 1: Details on Grid Availability and Surrounding Community in Potential Demonstration Sites**

S. No.	Farm	Power generation potential (kW)	Surrounding village (Pop.)	Status of Grid Availability
1.	BVB Investment Cop.	187.5	18 villages with total household of 3,386 households (16,533 people) across 3 communities namely Kampong Thma, Kraya and Ti Pou.	Expected to connect to national grid between 2020 to 2029
2.	Mr. Hok Heang Farm	20	2 villages with total household of 333 households (668 people) within Kandaol Dom commune	Expected to connect to national grid between 2019 to 2020
3.	7NG Group Co. Ltd	70	16 villages with total household of 2,092 households (10,463 people) within Traeng Traueng	Expected to connect to national grid between 2022 to 2029
4.	SOMA Group Co. Ltd	120	2 villages with total household of 2,382 households (11,910 people) surrounding the farm location	Expected to connect to national grid between 2025 to 2027
5.	Smart Mekong	50	2 villages with total household of 326 households (1,632 people) surrounding the farm location	Expected to connect to national grid between 2025 to 2028
6.	Rattanak Visal Investment Cop.	21	3 villages with total household of 326 households (1,632 people) within An long Thnot commune	Expected to connect to national grid between 2028 to 2030

At this stage, the demonstration project sites are yet to be finalized. It will be done during the PPG stage. Hence, the exact estimate of the number of households to be electrified as a result of the project will also be made during the PPG stage.

However, *UNIDO rapid potential assessment study* in animal farms in the year 2011, which identified few potential demonstration sites, found that there are at least 2 villages within the proximity of the animal farms (as given in the above table).

All the above information would be established in the PPG stage. The exact details of the demonstration sites, their baselines, the power generation capacities, global environmental benefits, etc., will be assessed

<sup>16</sup> The following assumptions have been made in the estimation: a) daily waste generation for cows = 10 kg; Pigs = 1 kg; Chicken = 0.03 kg, b) assuming 24 hours operation of gas engine, c) 2 kWh for every 1 m<sup>3</sup> of biogas and d) 1 m<sup>3</sup> of biogas from 25 kg of cow dung, 20 kg of pig manure or 12 kg of poultry droppings.

<sup>17</sup> Figures on year of connection to national grid are extracted from Sustainable Rural Electricity Plan (SREP) was developed in 2009 by the MIME with technical support from Innovation Energie Développement (IED).

Figures on number of population are cited from commune data base of the national committee for sub-national democratic development (NCDD), 2010 (<http://db.ncdd.gov.kh/cdbonline/home/index.castle>).



in the feasibility study during the PPG stage. The exact economics of the biogas power generation cost, affordability and income levels of the communities will also be studied in depth during the PPG stage.

Other necessary project development assistance will be facilitated through GEF grant. The GEF grant will also be used to provide incentive towards equipment purchased, within the limits set by the principles of incremental cost.

#### Level of Tariff

There is a sub-decree on “*Principles for Determining the Reasonable Cost in Electricity Business*” which also covers mini-grid operated by licensed REE. The reasonable cost (level of tariffs) is determined by:

- 1) Operation and maintenance costs
- 2) Cost of fuel purchases
- 3) Administrative and general management costs
- 4) Power purchase costs
- 5) Depreciation costs
- 6) Profit and cost of loan employed
- 7) Other costs as considered reasonable by the Electricity Authority of Cambodia (EAC)

In the process of review and setting tariff, each Licensee should submit the accounting reports and information, including information on each component stated above, to the EAC (authority for setting up the tariff).

However, it has to be noted that the sub-decree clearly states that “The Authority shall not require Licensees to provide electric power services where their reasonable costs cannot be recovered in full through tariffs”.

A Sustainable tariff, balancing the commercial viability and consumer’s ability and willingness to pay will be fixed only after a detailed feasibility study is done, considering the above mentioned decree.

#### Sustainable Operation and Maintenance systems

As explained earlier, under the project, an information centre for commercial biogas power plants will be established. This centre will provide continuous technical support on design, development, operation and maintenance of commercial biogas power plants. Regular training activities on O&M of bio-digester and mini-grids will be conducted.

Local engineering and O&M companies will also be trained to facilitate sustainable operation and maintenance of the demonstration and replication projects. In addition to this, biogas and mini-grid suppliers will train the O&M team of each demonstration plant.

By this way, operation and maintenance systems will be sustained beyond project completion.

#### Efficient Tariff Recovery system

A Sustainable tariff, balancing the commercial viability and consumer’s ability and willingness to pay can be fixed only after a detailed feasibility study is done.

Either one or any of the following methods will be practiced to ensure tariff recovery:

- a) Binding contracts for the electricity service will be signed with each user. All the users have to pay a substantial initial connection fee which creates a commitment among the end-users.

- b) In case of non-payment of electricity, the user would be disconnected and would have to repay his debts and a reconnection fee to be reconnected.
- c) Prepayment meters can be installed. With this system, the consumer needs to purchase in advance units of electricity from the REE and when they run out of credits, their supply shuts down. This arrangement also obviates the problem of reading, billing and tariff recovery altogether.

In addition to the above, few other tariff recovery methods would be studied.

Appropriate use of the above systems would enable the efficient tariff recovery in the project.

**Component 4: Monitoring and evaluation (M&E)**

The project will be subjected to mid-term and final evaluations. A mid-term M&E will be conducted and corrective actions will be taken. An independent final evaluation will be conducted three months prior to the terminal review meeting. The final evaluation will look at the impact and sustainability of results, including the contribution to capacity development and the achievement of global environmental benefit goals. The final evaluation will also provide recommendations for follow-up activities.

**Global environmental benefits**

The biogas based mini-grids established under this project will result in the avoidance of approximately 61,200 t CO<sub>2</sub>e<sup>18</sup> emissions directly, which would have otherwise resulted from the use of standalone diesel generators. It is expected that the market transformation will happen through inducement to many others to initiate and develop biogas based mini-projects for at least 2 MW cumulative capacity (replication factor of 2<sup>19</sup>) within a time span of maximum 10 years after the project, which then would lead to an avoidance of 122,400 t CO<sub>2</sub>e emissions indirectly. This is worth around USD 24.5 of GEF resources/ton of CO<sub>2</sub> emissions avoided directly and around USD 12.3 of GEF resources/ton of CO<sub>2</sub> emissions avoided indirectly. These initial estimates will be refined during the PPG phase.

**Incremental reasoning**

As of now, the deficit in energy supply or the supply demand gap is met through diesel generators. Therefore, the basis of incremental transformation is the replacement of diesel-powered electricity. The incremental cost of demonstration projects is shown in the table below. GEF funding will be used for meeting the incremental cost of replacing 1 MW of diesel based systems with equivalent biogas based mini-grids.

**Table 2: Global environmental benefits and incremental cost**

	<b>Baseline</b>	<b>Alternative</b>	<b>Increment</b>
Renewable electricity available for usage (MWh)	0	76,500	76,500
Diesel electricity displaced emission reduction, t CO <sub>2</sub> e	0	61,200 <sup>20</sup>	61,200
Investment, million USD	0.8	4.0	3.2

**Innovation, sustainability and scaling up**

An information centre for commercial biogas power plants is created to provide continuous technical support on design and development of commercial biogas power plants. They will sustain the promotional

<sup>18</sup> Refer to “Table 1: Global environmental benefits and incremental cost” for calculation.

<sup>19</sup> As identified during the UNIDO potential assessment study, many animal farms have expressed their readiness to invest in the technology after sufficient capacity building and improvement of financial environment. The farms who expressed their readiness include, Agro Star Investment, Ta Kley Farm, Rattanak Visal Investment Cop, Sino-Cambodia Breeding Pig Farm and Phnom Tamao Breeding Cattle Husbandry Station.

<sup>20</sup> Assuming an annual operating hours of 6,000 hours with 15% parasitic load, for 15 years and diesel emission factor of 0.8 t CO<sub>2</sub>/MWh (This is a conservative estimate as compared to the assumption used for initial PIF submission. In the initial PIF submission, annual operating hours of 7,500 was assumed).

and development activities within the sector.

Also, revolving fund will be setup for attracting investments in commercial biogas technology. Efficient tariff recovery mechanisms will be implemented to ensure the financial sustainability of the mini-grids.

These would remove the barriers faced by the sector currently. Since there is good replication potential, it is expected that, as a result of the project, more biogas based mini-grid projects would be established in other potential places.

**A.2. Stakeholders. Identify key stakeholders (including civil society organizations, indigenous people, gender groups, and others as relevant) and describe how they will be engaged in project preparation:**

Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Environment (MoE), university/technical institutions, private sector, banks/financial institutions are the main stakeholders. MoE (GEF focal point) will, as the chair of the steering committee, oversee the implementation.

University/technical institution will be responsible for the establishment of the information centre for commercial biogas power plants. All the main stakeholders will benefit through the capacity building and training activities.

MoE & UNIDO in association with AFD, along with a selected financing institution will be responsible for implementing and maintaining the revolving fund. Private sector will mobilize investments for establishing biogas based mini-grids. MAFF will assist in the establishment of the biogas based mini-grids. Local community people will benefit from the generated electricity and will get employment opportunities during construction and operation of the plants.

Eligible women candidates will be involved as trainers and technical consultants. TORs will be prepared in such a way, so as to encourage participation of women experts and to mainstream gender in the activities of consultants and experts. Moreover, women will also be encouraged to participate as trainees in the capacity building sessions.

**A.3. Risk. Indicate risks, including climate change, potential social and environmental risks that might prevent the project objectives from being achieved, and, if possible, propose measures that address these risks to be further developed during the project design (table format acceptable):**

Risk	Proposed Mitigation Measure	Risk Level
<p>Technical risk: Biogas generations in medium and large scale commercial farms are not common in Cambodia.</p>	<p>Capacity building will mitigate the technical risk. As Cambodia already has the technology for domestic biogas units, further improvement on development of commercial biogas units can be achieved with lesser difficulty.</p> <p>Moreover, an information centre for commercial biogas power plants will be established at a university or a technical institution (to be identified during the PPG stage). This centre will provide continuous technical support on design, development, operation and maintenance of commercial biogas power plants even beyond the project duration.</p>	<p>Low</p>
<p>Financial risks: Financial / credit constraints prevent investors from investing in the project.</p>	<p>Revolving fund will be established for supporting biogas based mini-grids investments.</p>	<p>Moderate</p>

<p>Sustainable operation risk: Application of biogas technology might be halted by the shortage of inputs.</p> <p>The sustainability of mini-grids is often highly dependent upon the efficient operation and maintenance systems along with effective tariff recovery schemes.</p>	<p>The installations will be done only after conducting a proper resource assessment study in order to ensure the supply of wastes from animal farms.</p> <p>All the O&amp;M staff of the demonstration projects will be trained by the respective suppliers. In addition, local engineering and O&amp;M companies will be trained in O&amp;M of biogas based mini-grid plants.</p> <p>Efficient tariff recovery schemes will be implemented to ensure the financial sustainability of the mini-grids.</p>	<p>Moderate</p>
<p>Climate Change risk: Flooding</p>	<p>Biogas plant and site office will be located on an elevated area to prevent flooding. All buildings and structures will be designed and built appropriately to avoid flooding.</p>	<p>Low</p>

#### **A.4. Coordination Outline the coordination with other relevant GEF financed and other initiatives:**

The project will build on experiences and achievements of the following projects to ensure that it is complimentary to each other.

- 1) *Rural electrification fund*: This is a GEF-WB project. Its objective is to increase the rural electrification through 12,000 solar home systems and 50,000 new electricity connections. It also aims at preparing complete feasibility study for mini and micro hydropower sites, facilitating project financing to REEs and construction of mini or micro hydropower plants. The proposed project is complementary to this project as it aims in increasing rural electrification by implementing commercial biogas based mini-grids for a cumulative capacity of 1 MW.
- 2) *Rural electrification and transmission project*: This is a GEF-WB project. It had the objectives of a) improvement of power sector efficiency & reliability, b) improvement of rural electricity and c) creation of enabling environment for RE sector commercialization and privatization. It also aims at supporting the private sector developers in providing new electricity connections. The proposed project is complementary to the above project as it aims to provide new electricity connections by creating new biogas based REEs.
- 3) *RE enterprise development-seed capacity access facility*: This is a GEF-UNEP global project aimed at African and Asian countries and covering a wide range of RE technology. This project encourages the use of RE products and services. It also aims to establish a Seed Capital Access Facility (SCAF), with governance structure and detailed operational parameters. The proposed project's efforts would be complementary in the way of providing specific incentives to biogas based mini-grids which has a significant potential in Cambodia.
- 4) *Climate change related technology transfer for Cambodia*. This is a GEF-UNIDO project promoting biomass power/cogeneration. In policy level, it aimed at strengthening the Cambodian government to develop necessary policies and regulations that can support development of mechanism and financial incentives for scaling up the development and transfer of biomass power generation technology. The proposed project also aims at encouraging REEs to generate power through biogas, exporting to grid and signing PPAs with government.
- 5) *National Bio-digester Programme (NBP) phase 1 (2005-12) and phase 2 (2013-16)*: The overall objective of the NBP is the dissemination of domestic bio-digesters as an indigenous, sustainable energy source through the development of a commercial, market oriented, bio-digester sector in Cambodia<sup>21</sup>. The proposed project (commercial biogas plants) would build on the existing capacity and knowledge on the domestic bio-digesters.

<sup>21</sup> <http://www.nbp.org.kh/>

## **B. Description of the consistency of the project with:**

### **B.1 National strategies and plans or reports and assessments under relevant conventions, if applicable, i.e. NAPAS, NAPs, NBSAPs, national communications, TNAs, NCSAs, NIPs, PRSPs, NPFE, Biennial Update Reports, etc.:**

The proposed project will support the following government policies and strategies targeted to increase the percentage of RE in overall energy mix and rural electrification in the country.

*Cambodia Power Sector Strategy (1999-2016)*: The major objectives of the policy are to: a) provide adequate energy supply throughout Cambodia, b) ensure a reliable and secured electricity supply, c) encourage environmentally and socially acceptable development of energy resources and d) encourage efficient use of energy.

*Renewable Electricity Action Plan (REAP) (2002-2012)*: This plan aims at providing cost-effective and reliable electricity to rural Cambodia through RE technologies. REAP is expected to provide electricity to over 145,000 households and commercial entities through installation and operation of 10 to 17 MW of RE generation.

*Technical Needs Assessment (2002)*: This policy identified the need for development of RE power generation.

*Rural Electrification And Transmission Project (2003)*: The main development objectives of the project are to: 1) improve efficiency and reliability of power sector, 2) expand rural electricity supplies, 3) strengthen electricity institutions and the regulatory framework, and 4) create an enabling environment for commercial and private sector.

*Renewable Energy Policy (2006)*: This policy created a framework for application of RE technologies to increase electricity access in rural areas. It envisions to: a) achieve 100% village electrification by 2020 and b) achieve 70% household electrification with grid-quality electricity by 2030.

*The Rectangular Strategy and the National Strategic Development Plan (NSDP) update (2009-2013)*: The plan emphasizes the importance of energy for the development of the country and sets priority to ensure efficiency, sustainability of production and supply, proper maintenance of the power infrastructure across the whole country and to promote the implementation of GHG mitigation projects.

*Second National Communication to UNFCCC (March 2010)*: This identified the energy sector as high potential options for GHG emission mitigation endeavor.

### **B.2. GEF focal area and/or fund(s) strategies, eligibility criteria and priorities:**

The proposed project activities promote the use of biogas technology for electricity generation replacing diesel usage. This area was selected due to its rapid scaling up and greenhouse gas (GHG) emission reduction potential. This is in line with *GEF-5 climate change focal area strategic programme CCM-3: Promoting the investment in RE technologies*.

### **B.3 The GEF Agency's comparative advantage for implementing this project:**

The project is a technical assistance/capacity development intervention that fits within the climate change focal area objectives CCM-3. The GEF Council paper "Comparative Advantages of the GEF Agencies" (GEF/C.31/5rev.1) recognizes the comparative advantage of UNIDO in this objective.

UNIDO is well placed to implement this project owing to its experience and expertise in implementing RE projects in agro-industries related access, waste management and productive use activities in other countries. It has, for example, already executed a similar project on biomass in Cambodia: *the climate change related technology transfer for Cambodia*. UNIDO will also work on the project through an in-house cooperation among relevant Branches including the Environment Management Branch, Business, Investment and Technology Service Branch as well as linking to Clean Production Centre in Cambodia.



In addition, UNIDO has an office in Cambodia with the Head of office coordinating the implementation of all its projects and programmes. In this context, UNIDO is well positioned to implement such a programme in Cambodia. It is quite clear that UNIDO has the necessary technical assistance capacity to successfully implement the project.

**PART III: APPROVAL/ENDORSEMENT BY GEF OPERATIONAL FOCAL POINT(S) AND GEF AGENCY (IES)**

**A. RECORD OF ENDORSEMENT OF GEF OPERATIONAL FOCAL POINT (S) ON BEHALF OF THE GOVERNMENT(S):** (Please attach the [Operational Focal Point endorsement letter\(s\)](#) with this template. For SGP, use this [OFP endorsement letter](#)).

NAME	POSITION	MINISTRY	DATE (MM/dd/yyyy)
Dr. Lonh Heal	GEF Focal Point	Ministry of Environment	03/01/2012

**B. GEF AGENCY(IES) CERTIFICATION**

<b>This request has been prepared in accordance with GEF/LDCF/SCCF/NPIF policies and procedures and meets the GEF/LDCF/SCCF/NPIF criteria for project identification and preparation.</b>					
<b>Agency Coordinator, Agency name</b>	<b>Signature</b>	<b>DATE (MM/dd/yyyy)</b>	<b>Project Contact Person</b>	<b>Telephone</b>	<b>Email Address</b>
Mr. Philippe Scholtès, Officer-in-Charge, PTC, UNIDO GEF Focal Point		10/31/2013	Mr. Jossy Thomas Project Manager, PTC/ECC/RRE 	+43 -1- 26026-3727	<a href="mailto:j.thomas@unido.org">j.thomas@unido.org</a>