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Establishment of Biogas Technology & Information Center (BTIC) in Cambodia

*GEF Project ID: 5421; GEF Agency Project ID: 120118
Reduction of GHG Emissions through Promotion of
Commercial Biogas Plants in Cambodia*

Final Report

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EXECUTIVE SUMMARY

UNIDO is supporting the government of Cambodia through a GEF-funded project to augment the usage of biogas technology for electricity generation in commercial animal farms of Cambodia for productive use. It aims at:

1. Improving human and institutional capacity for continuous development as well as sustainable operation of commercial biogas projects;
2. Supporting the development of biogas demonstration projects in order assist in scaling up the biogas technology; and
3. Enabling investment environment through creation of incentive scheme in support of biogas power plants in animal farms.

The project intends to overcome key barriers that currently limit the usage of biogas-based commercial electricity generation for rural electrification, reduce GHG emissions and mitigate adverse impacts on public health due to improper disposal of animal waste currently practiced by most plant owners.

Several activities have been identified to improve human and institutional capacity for the development and sustainable operation of commercial biogas systems. One of these activities concerns the establishment of a **Biogas Technology and Information Centre** (BTIC) to create awareness on Climate Change (CC) and build capacity on commercial biogas power plants. The BTIC is expected to act as *repository of technology information* and to provide necessary *training to various stakeholders*. Policy makers, interested project developers and operators of biogas power plants will be trained to gain confidence in biogas technology. To build a conducive (financial) environment an important strategy of the BTIC is to create awareness and interest among banks and financial institutions for lending to commercial biogas projects. Technology support will be provided for plant design and development as well as the sustainable operation and maintenance of commercial biogas power plants. Considering local circumstances, preference will be given to technologies available in the region to enable the provision of better after-sale service and to foster South-South cooperation.

Following are the main purposes of the BTIC:

1. Sensitize the issue of climate change and raise awareness on the positive role of commercial biogas systems among animal farm owners, and other relevant stakeholders;
2. Develop national technical capacity and expertise in biogas technology in which the Center will act as a repository of technology information based on technically available, economically viable, and environmentally desirable technologies in biogas;
3. Create networks with other biogas centers, researchers, project developers and suppliers of biogas systems across the region.

This document aims to provide strategic advice to the Project Manager and relevant counterparts in establishing a technology information center to promote biogas power. Following a review of the study undertaken by the project team to assess potential candidates to host BTIC in Cambodia, the document defines the sustainability strategy of the BTIC, starting with the definition of its structure and functions as well as the type of support that it would need from the project for its development

and functioning. The sustainability strategy includes the assessment of hardware needs, strategy for monitoring and evaluation and for promoting gender equality and the empowerment of women (GEEW) through the BTIC.

It includes a Business Plan that presents a Roadmap for BTIC development in three distinct phases: (1) the start-up phase; (2) the incubation phase; and (3) the sustainability phase. The start-up phase of approximately 6 months is essentially for the setting up of the BTIC so that it is prepared to fulfill the main purposes for which it is established. The incubation phase involves creating awareness and developing capacities of policy makers, project developers and financial institutions on issues related to the promotion of commercial biogas systems in animal farms. The BTIC will adopt a “learning by doing” approach in this phase to provide the necessary services while ensuring that the capacity of BTIC staff is strengthened to operate and manage the center, with support from the project team as well as international expertise. At the end of the incubation phase, the BTIC will be fully prepared to fulfill its mandate on its own, sustaining the project initiatives beyond the project life. The work plan in the sustainability phase will very much depend on the policies and strategies adopted by the institutional stakeholders to promote and support the development of biogas power and the competence gained by the BTIC team during the incubation phase.

The Work Plan is presented along with the resources and activities for the first two phases so that the BTIC can fulfil its mission successfully and sustain all the initiatives beyond the project life.

1. CAPACITY NEEDS ASSESSMENT AND ANALYSIS OF STAKEHOLDERS TO HOST BTIC

1.1. Capacity needs assessment for developing biogas power in Cambodia

Raw animal waste is usually a liability to farmers because it is full of pathogens and compounds like ammonia that can ruin crops and soil if applied inappropriately. Moreover, animal farms are a key cause of water pollution as the raw animal waste is prone to running off into waterways and leaching into groundwater. Anaerobic fermentation in bio digester allows turning the animal waste into resources that the farmer can use and even sell. Energy generated from biogas through combustion and power can be used efficiently in the farm and excess electricity may be sold. Fermented slurry (FS) sometimes called bio-slurry, as a by-product of the anaerobic fermentation in the biogas digester, could be used as organic fertilizer.

Therefore, UNIDO is supporting the government of Cambodia through a GEF-funded project to augment the usage of biogas technology for electricity generation in commercial animal farms of Cambodia for productive use. It aims at:

- (1) Improving human and institutional capacity for continuous development as well as sustainable operation of commercial biogas projects;
- (2) Supporting the development of biogas demonstration projects in order assist in scaling up the biogas technology; and
- (3) Enabling investment environment through creation of incentive scheme in support of biogas power plants in animal farms.

The project has identified **some barriers** for the development of biogas power in Cambodia. These can be classified into 5 categories, as follows:

- **Poor awareness of all stakeholders**¹ about the role that biogas power can play in addressing economic, environmental and social issues in the rural context;
- Farm and agro-industry owners do not have the necessary **knowledge and know-how** to design, develop and operate biogas systems;
- The **technology** for biogas power generation, including issues such as gas quality and composition as well as size/scale, **is not well known** in Cambodia though some end-users have already installed bio-digesters to minimize the adverse impact of wastewater;
- There are **limited financial resources** available for investment in biogas generation. One reason for this is that banks and financial institutions have practically **no exposure** to the functioning of a biogas power system and its economic performance, and they are not sensitized to the fact that the electricity generated can help to reduce fossil fuel use and/or generate revenue from its sale in rural areas;
- **Absence of suitable policy** (for example, no specific target set for bioenergy in the national energy mix with the aim to reduce the dependence on fossil energies); and **absence of a regulatory framework** (including the sale of the electricity generated at the farm to the national power grid and suitable electricity tariff to justify investment in biogas power) for the healthy development of biogas projects; and

¹ e.g. government and non-government entities, project developers, technology suppliers, local engineering firms, O&M service providers, financial institutions, etc.

- **Lack of resources and/or infrastructure** for the training and capacity building of individuals and institutions.

BTIC is expected to address these shortfalls in a holistic manner by serving as the resource base for training and capacity building of individuals and institutions, and undertake specific initiatives as outlined below:

1. **Development of Capacities** - To develop (skilled) women and men in Cambodia for harnessing biogas potential the center may begin with building necessary capacities of the developers of identified potential biogas systems to be established within the project period and of policy makers involved in the project as well as financial institutions involved in financing the pilot biogas power plants. For this purpose, BTIC may spearhead relevant activities including the following:

- Impart training through tailored and regular short term and medium term training programs to persons directly involved in biogas development
- Imparting education at the undergraduate and post-graduate levels to students in subjects directly relevant to biogas development, e.g. veterinary, engineering, agriculture.
- As part of the UNIDO-GEF project a series of “Train the Trainers” and “Train the Experts” will be provided in biogas technology– both classes, field practices and study tours – for technical capacity development, the BTIC Team will be expected to participate actively. The host should ensure that all the BTIC team members will be provided enough time to join without any effects on their salaries or assigning further workloads.
- Organize relevant capacity building and training courses on all aspects of biogas power for interested stakeholders/ various target groups (e.g. training on the design, development and operation of biogas power system for farm and agro-industry owners; capacity building of institutional stakeholders on the importance of setting specific target for bioenergy development, training of financial institutions on the scope and opportunities for green financing that supports bio-energy, etc.)
- In collaboration with the project, the Centre will conduct assessments of trained personnel and develop certification/ registration schemes which reflect their knowledge and capacity following the training imparted by BTIC. Only qualified individuals and companies should be included on the Center’s website/database of qualified experts that will be accessible to the public.

2. **Sharing of Information and Raising Awareness** - To create greater awareness among the different group of stakeholders about how biogas power can contribute positively to the economic, social and environmental development in rural areas. Following are the types of activities that the BTIC can undertake:

- Act as an information hub for creating greater awareness among all stakeholders on the economic, social and environmental benefits of biogas power development, especially in the rural context;
- Collect, analyze and share technical and economic information on biogas technology for sharing with farm and agro-industry owners;
- Maintain an up-to-date and reliable directory of biogas technology suppliers in the Mekong region;

- Create awareness on climate change issues as well as crosscutting issues such as nexus and gender aspects during all above-mentioned activities.
3. **Advisory services and Technical Support** - Provide consultancy services to biogas project developers and financial institutions for promoting biogas development. Following are the activities that the BTIC may undertake:
- Provide consultancy services and technical support for new biogas systems as well as for renovation and modernization of existing biogas systems, such as biogas resource assessments, feasibility studies, or performance improvement studies.
 - Develop National laboratory for performance testing and certification.
 - Carry out Environment (and social) Impact Assessment and eco-restoration studies.
 - Give advice on adapting and formulating available Guidelines and Standards for biogas power projects in Cambodia.
 - Provide inputs to institutional stakeholders for developing suitable policies and regulatory options;
4. **Networking** - To ensure continuous development of the BTIC, the center should
- Co-operate and collaborate with relevant centers, universities or institutes across the region to learn and share experience.
 - Co-operate and collaborate with other national, foreign and international organizations in the field of biogas.
 - Engage technology suppliers in the region to facilitate transfer of technology as part of procurement and after-sales services.
 - Create a database of existing biogas systems and stakeholders engaged in the sector including government institutions, financing institutions, equipment suppliers (local and foreign) and contractors and dissemination information to the users.
5. **Quality control**
- Ensure compliance with applicable laws in Cambodia, develop and implement mechanisms for quality accreditation, and monitor trained biogas experts/technicians who would provide active services in the Cambodian territory;
6. **Research and development**
- Foster R&D for continuous development of biogas systems in Cambodia.

1.2. Analysis of stakeholders for hosting BTIC²

Stakeholders' analysis is important not only to assess the capacity and suitability of the potential candidates to host the BTIC but also recognize the capacity gap in the case of the most suitable candidate so that the project can plan to provide adequate support for strengthening the capacity. Apart from analyzing organizations, the focus is also on assessing the awareness, knowledge, technical and managerial skills of the members of the organizations, as well as their ability to get the various stakeholders involved, strengthen their joint vision, goals and shared values, improve their relationships, build trust and increase knowledge exchange.

² This section summarizes a detailed study that was undertaken by the UNIDO Project Management Unit (PMU) in Cambodia: "An assessment of potential candidates to host Biogas Technology Information Center".

Capacity needs assessment was carried out by the Project Management Unit (PMU) to create ownership, facilitate dialogue and guarantee transparency. It is crucial for the project to ensure sustainability of the BTIC beyond the project life. Accordingly, the project has considered certain criteria for the selection of a suitable institute that can host the BTIC:

- The host should have a vision to establish BTIC that serves as a Biogas Centre of Excellence; and
- The host should agree to integrate the BTIC into its organizational structure to administratively sustain the center in the long-term.

Further, the study conducted by the PMU has listed some **criteria** to ensure good performance and sustainability of the BTIC, such as:

- Strong mandate to work on animal production and biogas and/or agricultural sectors;
- Considerable experience of R&D in biogas technologies or renewable energies;
- Human resources in the required specializations to ensure satisfactory performance and service delivery;
- Strong commitment to structure and integrate the BTIC with the desired activities to ensure its sustainability;
- Ambition to develop the center as a leader in biogas technology for the benefit of the public;
- Commitment to actively collaborate with the project and UNIDO by assigning personnel to operate the center and participate in the training programs for strengthening their capacities;
- Good networks in energy engineering and/or biogas technology, which enables the center to quickly respond to the requests from farm owners;
- Provision of open access to BTIC, particularly to the target beneficiaries of the project.

Using the above criteria, the project undertook a detailed assessment of **5 potential candidates** to host the BTIC through visits and interviews/discussion, namely:

- Prek Leap National School of Agriculture (PNCA),
- Royal University of Agriculture (RUA),
- Institute of Technology of Cambodia (ITC),
- Phnom Penh Institute of Technology (PPIT), and
- Department of Animal Health and Production (DAHP).

The aspects that were critically analyzed included the vision and mission of the organization, its technical capacity, current activities and future directions, and a detailed SWOT (Strength, weakness, opportunities and threats) analysis. The competitive advantages of each organization were assessed using the following **7 criteria**:

- Mandate/competence on animal production or biogas promotion;
- Vision and commitment to integrate the BTIC into the organization;
- In-house human resources to meet the BTIC requirements;
- Capacities and experience in biogas technology applications;
- Liaison/facilitation with various stakeholders;
- Financial issues related to BTIC operation; and
- Ease of access.

Preliminary surveys undertaken by the project concluded that there is no single entity in Cambodia with the full capacity and expertise necessary for fulfilling the objective of BTIC. However, the **Royal University of Agriculture (RUA)** obtained the highest score out of the 5 organizations, mainly due to its strong vision and commitment to host and internalize the BTIC; also, human resources are available within the institution to cater to the specific needs of the BTIC and RUA has the capabilities and experience in biogas technology applications.

It must be noted that the **DAHP** also expressed its willingness to host the BTIC as it sees BTIC as an effective medium to enforce the newly adopted Law on Animal Health and Production that encourages on-farm management and treatment of animal waste. DAHP is already actively engaged in promoting the development of biogas systems at the household level so that the gas generated from the small bio-digesters can be used mainly for cooking and reducing the pressure on deforestation. However, the technology employed for biogas generation and utilization at the household level is very different from that needed for commercial biogas development at animal farms. RUA may nevertheless benefit by cooperating and networking with DAHP as both projects are focused on the use of animal waste for developing biogas systems in the rural environment.

The procedure adopted for assessing the suitability of the identified candidates and the analysis done to select the most suitable candidate to host the BTIC seems fair and just, especially considering the following: The main activities of the BTIC are identified as information dissemination, conducting targeted training, and provision of advisory services. All these activities require that BTIC staff should be qualified and knowledgeable individuals who work in an unbiased manner to carry out the specified activities. Since the subject pertains to on-farm management and treatment of animal waste, RUA takes the lead in comparison with the other candidates.

RUA is a leading public agricultural university in Cambodia operated by the Ministry of Agriculture, Forestry and Fisheries; hence RUA can expect assistance from the Provincial Departments of Agriculture, Forestry and Fisheries to reach out to the farms more effectively. The focus of RUA is the advancement of human capacity in agricultural development. Moreover, RUA has also shown interest in developing the capacity of its resource persons to provide consultancy services and involving its students in research activities.

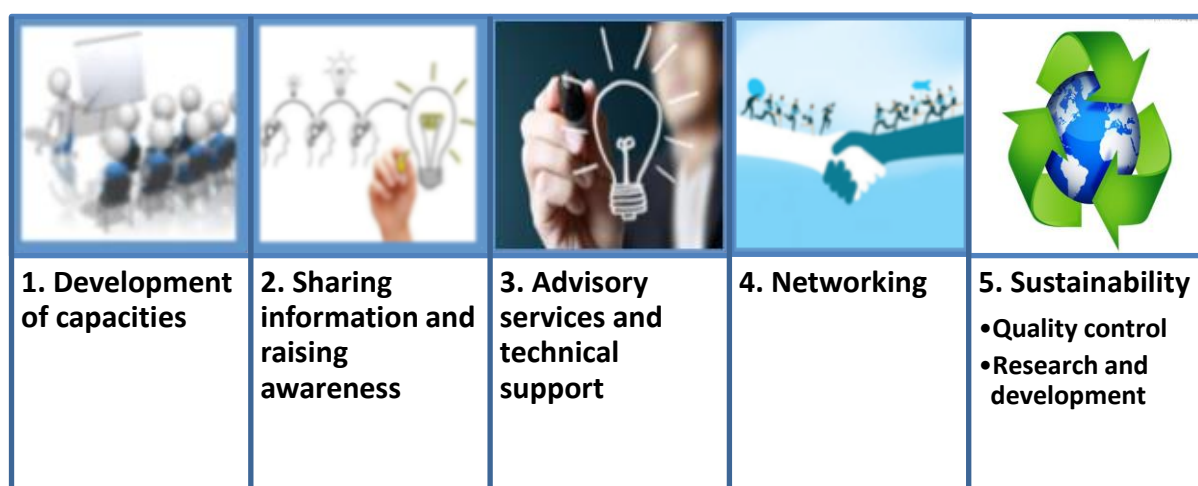
2. SUSTAINABILITY STRATEGY FOR THE BTIC

2.1. Structure and function of the BTIC

The BTIC will have a mandate to improve human and institutional capacity for continuous development and sustainable operation and maintenance of commercial biogas projects in Cambodia. This chapter deals with the structure and function of BTIC to fulfill its mandate as well as sustain all the initiatives beyond the project life.

2.1.1 Structure of the BTIC

Three major pillars of activities identified to fulfill the mandate of BTIC include *training and capacity building, information dissemination and R&D, and consulting (advisory services and technical support)*. The success of BTIC will also depend on how well it can create a dynamic network of the key stakeholders and how far it is successful in sustaining activities beyond the project life by undertaking research and development and ensuring quality control of all activities.



The initial structure (administrative set-up) of BTIC is presented in Figure 1 based on the need to fulfill the above pillars of activities. The structure can be reorganized in future to suit the evolution and future activities of BTIC. The BTIC team should consist of personnel with different complimentary expertise to ensure timely and effective delivery of services to the different stakeholders. It should be noted that the positions shown in the organigram are **not full-time jobs**. While the personnel to be mobilized would very much depend on the activities to be undertaken, there would be the need for having **an assistant** who would work full-time for facilitating interaction with the different stakeholders. A senior representative of RUA with management experience will serve as the **coordinator of the BTIC** on part-time (25% of the time). Trainers in training unit can be personnel from the other units. The trainer should have the competency related to the training course. This also helps to develop the competency of BTIC team.

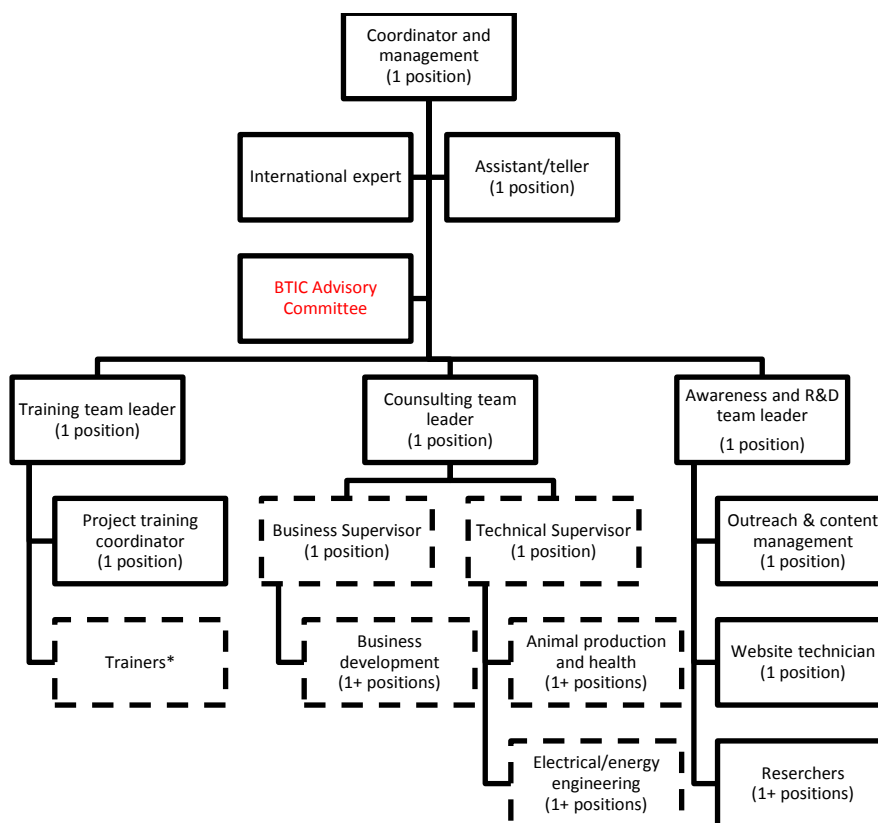


Figure 1. Proposed BTIC structure (administrative set-up)

The project has identified the need for certain expertise/specialization within the BTIC for the provision of services to targeted stakeholders. These include **biogas specialist, electrical/energy engineer, business developer, outreach manager, and website manager.**

Table 1. Personnel/expertise needed for the effective functioning of BTIC

(source: ToR of Biogas Technology Information Center)

No.	Personnel/expertise needed	Persons	Time allocation (Full time = 100%)	Expected role in the BTIC
1	Coordinator	1	25%	Team Leader to lead in coordinating among stakeholders. Establish and maintain networks. Develop and implement new ideas and strategies for the BTIC.
2	Animal production and health specialist	1+	On demand	Assess biogas production and greenhouse gas reduction potential; Understand dimensions of biogas systems that are related to animal production and health.
3	Electrical/energy engineer	1+	On demand	Assess energy demand and system sizing and optimization; Understand electrical dimensions of biogas systems.
4	Business development manager	1+	On demand	Develop biogas project proposals upon request from farm owners, and development of the center's marketing strategy. Understand financial and economic dimensions of biogas systems.

5	Outreach & website manager*	1+	On demand	Disseminate and ensure outreach activities, maintain website, manage website content, establish and maintain mailing list, establish and maintain databases, etc.
6	Assistant	1	100%	Provide information to farms seeking basic information from the center, and forwarding specific technical queries to the concerned experts. Support with the organization of training programs.

* Web site development could be outsourced whereas one person can take care of outreach activities as well as website management.

2.1.2 Decision making at the BTIC

To ensure smooth and coordinated functioning of the BTIC, RUA should nominate 5 of its staff to represent in the BTIC advisory committee with the responsibility to oversee BTIC's sustainable operation.

2.1.3 Functions of the BTIC

As a one-stop-shop for biogas development activities in Cambodia, the BTIC will provide service to meet all aspects fulfilling the objectives of BTIC. The role and responsibilities for each position are presented in Annex 1.

Training unit: The training unit has the responsibility to develop human resource on biogas power for all interested stakeholders in Cambodia. The relevant activities related to training and capacity development are elaborated in Chapter 3.

Consulting unit: The consulting unit provides technical and business support about biogas projects to project developers and financial institutions. It also has the responsibility to create networks among relevant centers, universities, institutes and technology suppliers across the region to learn and share experience about biogas. The activities related to consulting are elaborated in Chapter 3.

R&D and information dissemination unit: This unit is responsible for gathering and sharing information related to biogas and other renewable energy. The unit will, at a later stage, conduct research related to biogas for strengthening the knowledge base in Cambodia. The relevant activities of R&D and disseminating unit are elaborated in Chapter 3. It should be noted that this activity is particularly in line with the mandate of RUA as it will contribute positively to the teaching curriculum and research initiatives of the institute.

2.2. Sustainability strategy for the BTIC

Following are the expected outputs from the activities that would be undertaken by BTIC:

1. Awareness raised among key decision makers, stakeholders, farm/ slaughterhouse owners, NGOs, and other relevant institutions interested in biogas systems, climate change and greenhouse gas mitigation measures.
2. Capacity developed for:
 - a. Local project developers and farm owners in designing, developing and implementing biogas power projects in farms;

- b. Banks and financial institutions in providing investment support aimed at biogas power projects in farms; and
- c. Policy makers in formulating policies and regulations that help create an enabling environment for investment in biogas technologies.

The long-term goal of the project is to reduce GHG emissions related to methane emissions from animal waste and those related to fossil fuel consumption in farms in Cambodia. This goal can be fulfilled if more and more animal farms opt for biogas power generation which will also lead to economic, social and environmental benefits. During its short life span, the project has a role not only to create the enabling environment for achieving the expected outputs and outcomes, but also ensure the sustainability of the initiatives to contribute to the ultimate project goal. The very purpose of the creation of the BTIC is to build and strengthen the capacities of the key stakeholders. Hence it is important that the BTIC continues to remain active beyond the project life. For this purpose, BTIC should develop a strategy to cost-effectively sustain its activities to not only establish but also scale up the above initiatives during the project life using a three-phase development approach (**start-up phase, incubation phase and sustainability**) which are elaborated in the next Chapter.

Accordingly, BTIC needs to adopt a sustainable business model that allows it to generate the resources needed for carrying out well-targeted activities such as:

1. Gathering and sharing general information to create awareness among all stakeholders;
2. Providing training to build capacities for commercial biogas power plant design and development, as well as its' O&M;
3. Engaging technology suppliers in the region for technology transfer as part of procurement and after sales service;
4. Facilitating access to finance for biogas power plant projects;
5. Advising and informing public decision makers on policies and best practices in the area of biogas development in relevant countries to support smooth development of biogas power;
6. Supporting research and development in advanced biogas technologies; and
7. Networking with other biogas centers, researchers, project developers and suppliers of biogas systems across the region.

It should be kept in mind that the successful operation of BTIC beyond the project life would depend much on the type of support provided by the Cambodian government, in terms of adopting policies and providing incentives. Parallel to the government support, it is important that BTIC can well train and maintain the core staff beyond the project life by mobilizing the resources needed for it.

2.3. Target beneficiaries and the expected services to be delivered by BTIC

The BTIC may consider the following as **target beneficiaries** for undertaking the activities listed in Chapter 2.2:

- Policy makers
- Farmers, livestock companies and agro-processing factories
- Project developers and local engineering firms (for both setting up biogas power plants and ensuring their smooth and effective performance)
- Banks and financial institutions

- Researchers and students
- Non-Governmental or Civil Society Organizations (NGOs, CSOs), etc.

The **services** that the BTIC needs to deliver may be broadly classified into 4 categories: training and capacity building, information gathering and knowledge dissemination, advisory services, and research and development.³ Some of the potential activities under each category are listed below:

1. Training & capacity building

- a. Management of waste from an animal farm;
- b. Detailed techno-economic feasibility study;
- c. Financing of commercial biogas plant (how to develop bankable proposal)
- d. Model farm for waste management and energy generation;
- e. Farm electrification and revenue from excess electricity;
- f. Bio-digester slurry application in agriculture;
- g. Biogas market assessment and mapping;
- h. Operation and maintenance of biogas system;
- i. Animal production and veterinarian prevention services;
- j. Business incubation within innovative and entrepreneurship ecosystem (social and economic wealth); and
- k. Conferences/seminars related to biogas or renewable energies.

2. Information gathering and dissemination

- a. General technical and economic information about bio-treatment of farm waste for energy generation and the utilization of byproducts such as bio-fertilizer (including development of simple phone applications aimed at farm owners for preliminary ex-ante estimation of biogas potential);
- b. Good practices of farm waste management, health, hygiene and environmental protection;
- c. Laws, regulations and policies related to biogas power generation, conditions for the sale of electricity to the grid and the electricity tariff favoring electricity from renewable energy sources.
- d. Minimum criteria for a farm to install biogas system for electricity generation;
- e. Database of established biogas systems, commercial farmers, suppliers of biogas technology equipment, relevant technicians, engineering companies specialized in biogas utilizations in the region, electricity providers which cover commercial farms, bio-fertilizer suppliers, banks that provide loans for the agricultural sector, government and non-governmental organizations associated with biogas production;

³ *The same team within the BTIC will carry out information gathering and dissemination as well as research and development.*

- f. Issues related to farmer cooperatives, entrepreneurship, and business incubation networks; and
- g. List of contacts, first help, Q&A screens in the website.

3. Advisory services

- a. Helping animal farms to develop bankable proposals and access credit;
- b. Helping banks and financial institutions (FIs) to evaluate biogas projects (technical, social and economic feasibility);
- c. Playing an effective and unbiased intermediary between project developers, FIs and technology providers;
- d. Developing techno-socio-economic feasibility study of biogas system development;
- e. Technical assessment of existing facilities to explore the scope for performance improvement;
- f. Developing and implementing a mechanism for quality accreditation of trained biogas experts and technicians; and
- g. Setting up business models and ensure sustainability of business incubators.

4. Research & Development

- a. Issues related to biogas production, such as optimization, commonly faced O&M challenges and solutions in the farms;
- b. Biogas slurry application in agriculture;
- c. Optimized farm electrification through judicious choice of farm equipment that promote efficiency and meet the specific needs in the farm;
- d. Management of waste from animal farm;
- e. Development of advanced biogas technology that minimizes the sulfur compounds while ensuring good performance with various types of feedstock;
- f. Hosting students for internship and research;
- g. Establishing contacts and networks, and developing research projects with other competent and interested partners; and
- h. Analyzing the policies and regulatory environments that promote or hinder biogas development.

2.4. Needs of the BTIC and support from the Project

While RUA has shown strong interest and willingness to host and sustain the BTIC, it will require support from the project mainly to strengthen the technical capacity of its personnel and for BTIC operation to comply with the BTIC mandate. This is particularly important during its initial phase till the BTIC can generate adequate resources to cover its operational expenses by the time the project comes to an end.

Hence the project envisages extending support to BTIC in the following manner:

- Strengthen capacity and develop technical skills of the BTIC team in the field of advanced biogas technology;⁴
- Provide exposure to biogas technology through study tour(s);
- Extend support for setting up BTIC and provide resources such as reference books and documents;
- Mobilize international experts to assist in developing training contents and consultancy services;
- Support with designing of a website and its operation and for developing promotional activities;
- Equip the BTIC with the instrumentation needed for field performance evaluation and monitoring of biogas plants (e.g. gas analyzer, energy logger, substrate testing kit, etc.) and office appliances (laptop, scanner, camera, furniture, etc.);
- Provide operating budget during the project implementation period.⁵

2.5. Hardware needs assessment

Some basic hardware would be needed to fulfill the BTIC mandate and to operationalize the BTIC.

Those include:

1. Office space;
2. Notebook computers with high-capacity hard drive for data storage (minimum of two as one would be exclusively meant for contents development, outreach and website updating activities);
3. Networked laser printer with capacity to scan, print and digitize (convert documents, objects, and images into digital form);
4. Hardware for accessing good quality internet;
5. Projector for conducting trainings and workshops;
6. Books, documents, software tools, and videos related to biogas systems;
7. Scale model of an animal farm with biogas digester and power generation facility;
8. Camera for documentation of project activities;
9. Office supplies.

Additional hardware required include devices that may be used for concrete diagnostic and feasibility studies as well as performance monitoring in animal farms. *The actual additional hardware requirements will be defined by the biogas technical adviser hired for the project.*

⁴ During the mission, a couple of meetings were held with the RUA staff who have shown strong commitments to serve in the proposed BTIC. Some of them expressed that while they can understand the theories of farm waste management and biogas power generation, they lacked practical experience and exposure.

⁵ BTIC will require a small budget for its day-to-day office operation and maintenance. Instead of expecting a grant for this purpose, BTIC should include such costs as part of BTIC's overhead cost while preparing the budget for the concrete capacity building, awareness and advisory activities that will be programmed in a periodic manner, typically on a yearly basis.

2.6. Monitoring and evaluation (M&E) strategy

The monitoring and evaluation (M&E) process provides the necessary input to continuously adapt to changing capacity development needs. It also helps to evaluate successes, failures and the impact of the capacity development initiatives. The monitoring and evaluation strategy adopted for the BTIC will be in line with the project document. The BTIC will submit a **quarterly progress report** to the Project Management Unit (PMU) to summarize the main activities undertaken and the progress towards the achievement of expected outputs. As mentioned earlier, the BTIC will undergo 3 phases of development to ensure its sustainability. Accordingly, at the end of each phase, the quarterly report will be replaced by a more **comprehensive report** that will summarize the results achieved against the targets set and share information to serve as source of verification. Details of the M&E strategy along with the verifiable indicators, both quantitative and qualitative, can be found in Chapter 3.

2.7. Gender mainstreaming strategy

Although the project document lays down that the biogas power project has “limited gender dimensions”, UNIDO recognizes that all energy interventions are expected to have some impact on people and are, therefore, not gender-neutral⁶. Hence the project’s aim is to demonstrate, wherever possible, good practices in mainstreaming gender aspects into biogas projects. As far as the BTIC is concerned, it would include the following:

AREA	GOAL (samples)	APPROACH (samples)
BTIC Staff	The selection of staff for the BTIC will be gender-sensitive. (min. 30% female staff)	Recruitment of the staff for the BTIC as well as the experts to strengthen BTIC capacity will consider gender balance as well as gender awareness of staff and experts (for instance, gender awareness and knowledge on gender dimensions will be included as requirements in gender-responsive ToRs for the experts).
	BTIC staff should internalize gender issues in all their activities.	The training of staff of BTIC will include basic knowledge on gender concepts and gender mainstreaming.
BTIC Activities	All BTIC activities will be gender mainstreamed.	Efforts will be made to promote that women have equal participation in, access to and decision over activities such as those related to awareness raising and training activities.
1. Capacity Development	Minimum 20% female participants in trainings. All training participants learn also about energy-gender nexus.	All training modules will include materials that support gender mainstreaming. All capacity development activities that involve stakeholders will include issues related to gender equality and women’s empowerment. Announcements of training and training activities will encourage relevant organizations or companies

⁶ UNIDO’s Policy on Gender Equality and the Empowerment of Women, issued in 2009 and updated in 2015 (http://www.unido.org/fileadmin/user_media_upgrade/What_we_do/Topics/Women_and_Youth/DGB110Rev2_gender_policy.pdf), sets out the Organization’s gender equality commitments. The Gender Equality and Empowerment of Women Strategy 2016-2019 (http://www.unido.org/fileadmin/user_media/PMO/GC.16/GC.16_8_E_Gender_Equality_and_Empowerment_of_Women_Strategy_2016-2019.pdf) provides a clear results-oriented framework and plan of action.

		<p>to nominate women participants.</p> <p>All training materials will be gender-sensitive, e.g. not promote gender stereotypes.</p>
2. Advisory Services and Technical Support	Minimum 20% female experts.	<p>Guidance to project developers will include specific questions related to gender analysis tool that considers gender dimension of a project.</p> <p>Attention will be paid to foster gender parity/equality amongst experts.</p>
3. Networking	At least one partner is actively promoting gender equality and women's empowerment.	<p>Special attention will be made to incorporate partners who are actively promoting gender equality and women's empowerment.</p> <p>All network partners, being it experts, cooperating institutions, farms, or others should be gender aware, e.g. receive basic gender training.</p>
4. Information sharing and awareness raising	All BTIC materials will be gender mainstreamed.	<p>All materials developed for information sharing and awareness raising will highlight the specific issues related to gender discrimination and emphasize the importance of gender equality.</p> <p>All material will be available to both women and men.</p> <p>All materials will be gender sensitive, e.g. not promote gender stereotypes.</p>
5. Research	Minimum 20% female researchers.	<p>Data gathering efforts or assessment studies will take gender dimensions into consideration by ensuring sex-disaggregated data collection and gender analysis.</p> <p>Attention will be paid to foster gender parity/equality amongst researchers.</p>

3. BUSINESS PLAN FOR THE BTIC

3.1. BTIC roadmap

The commercial biogas technology is at a very rudimentary level of penetration in Cambodia and there is a lack of adequate human and institutional capacity to promote the development of commercial biogas projects. Hence it is proposed that the BTIC be developed in three phases to ensure its sustainability.

As shown in Figure 2, the first phase can be called “**Startup**”, the second phase is “**Incubation**”, and the last is “**Sustainability**”. The different activities and the business plan for each phase will be elaborated. The phases will be designed such that the outcomes from one phase will serve as resources for the next phase. These are explained in more details in the following sections.

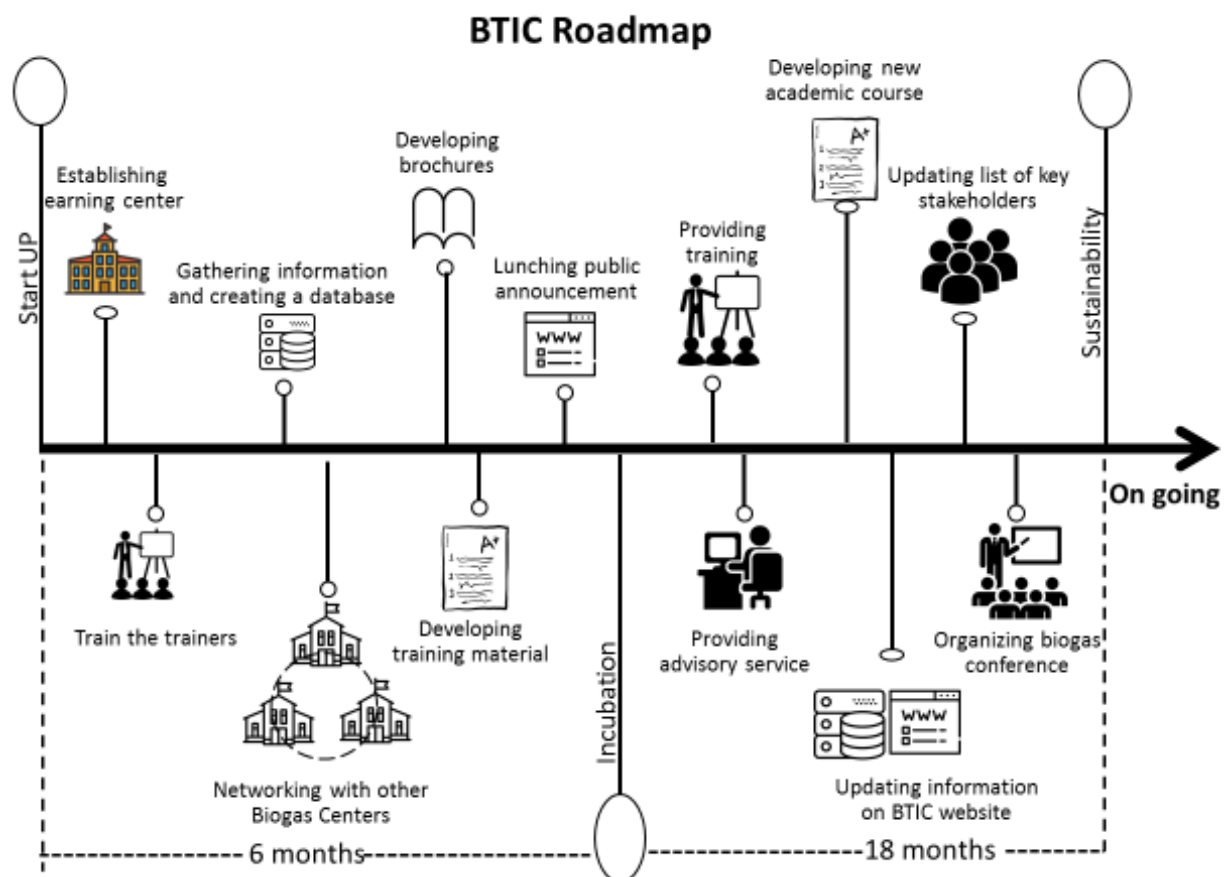


Figure 2. Proposed development of the BTIC in 3 phases (start-up, incubation and sustainability)

3.2. The start-up phase (6 months)

3.2.1 Objective and the expected outputs of the start-up phase

The **start-up** phase is meant to assist in the setting up of the BTIC and to provide the necessary support for building the capacity of BTIC to carry out the different tasks to fulfill its role. This phase may be roughly for 6 months though capacity building is something that may continue to happen for much longer time, throughout the period of project execution.

During this phase, it should be kept in mind that there is practically very little experience in Cambodia on medium/large scale biogas power. This goes without saying that the level of knowledge

on the subject is limited and no organization in Cambodia is known to be conducting research on advanced biogas technology. Therefore, the capacity building should be limited to developing basic competence that can be further upgraded with the passage of time. The following outputs are expected to be achieved in the start-up phase:

1. The organizational structure of BTIC is established;
2. The BTIC personnel are trained and their capacity strengthened on biogas technology;
3. Network with other biogas centers, researchers, project developers and suppliers of biogas systems in the region is created;
4. Information is gathered and database for the promotion of biogas power created;
5. Training and learning materials for the learning center based on available resources are developed and customized;
6. Brochures/leaflets and website are prepared;
7. Public announcement made and media campaign launched to publicize BTIC services.

3.2.2. Key activities of the start-up phase

As shown in Figure 3, the main activities during this phase will be devoted to setting up the BTIC, creating awareness, training the trainers, networking for knowledge and technology transfer, etc.

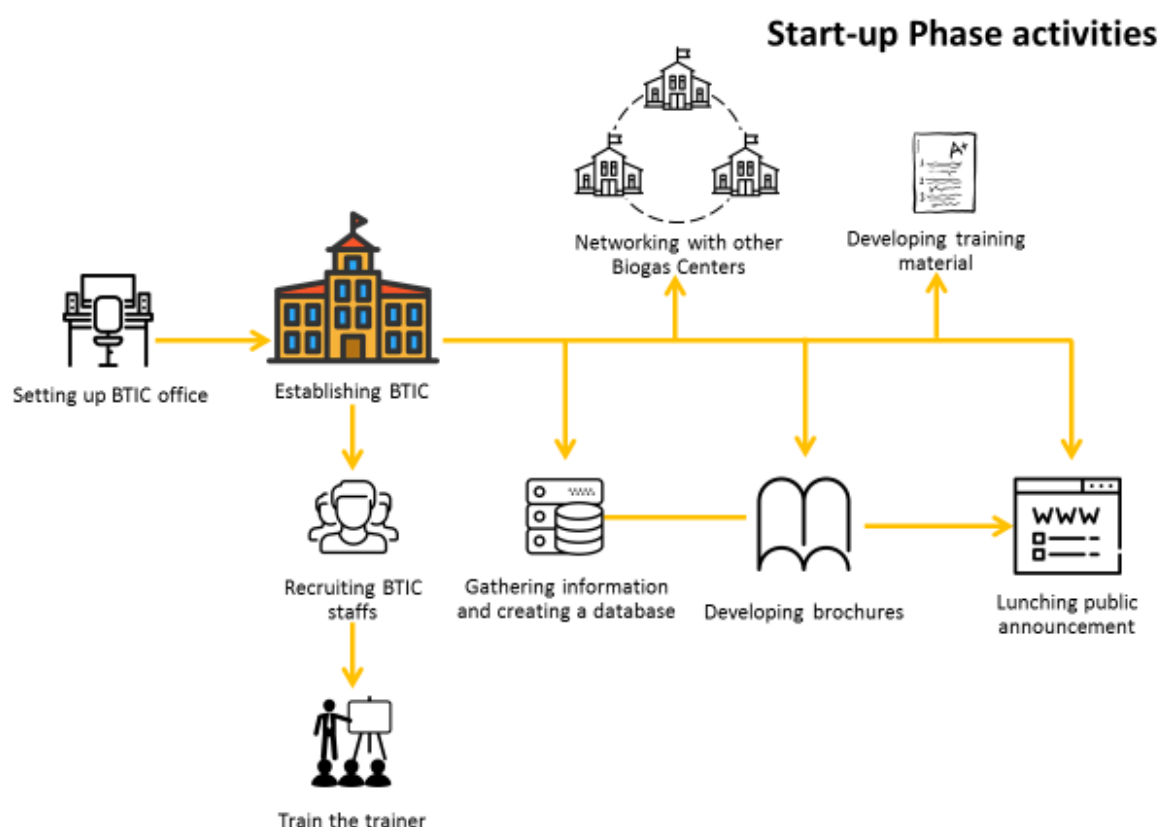


Figure 3. Proposed activities during the start-up phase

Table 2 provides a summary of activities, expected results, source of indicators, human resources to be mobilized and an indicative budget for conducting the activities.

Table 2. Detailed description of the start-up phase (Phase 1) with indicative budget

Phase	Outputs	Activities	Result	Source of verification	Human Resources	Budget (US\$)
1.1	BTIC is established	1.1.1. Identification/recruitment of qualified personnel based on the profile of the expertise needed at the BTIC	Official organigram with names of the experts	Official BTIC organogram	Coordinator, Assistant	
		1.1.2. Acquiring of hardware needed for the functioning of the BTIC	Hardware acquired and BTIC is functional	1st quarterly progress report	Assistant	5,000
		1.1.3. Familiarizing BTIC team with the business plan and half-yearly work plan of BTIC	BTIC Business plan and work plan discussed by PMU with BTIC team and fine-tuned	Revised/finalized business plan and work plan	BTIC team	
1.2	BTIC personnel are trained and their capacity enhanced	1.2.1. Targeted training sessions are organized by PMU for BTIC experts	BTIC experts get familiar with the role they are expected to play	"Training the trainer" evaluation report	BTIC team	
		1.2.2. BTIC staff getting on the job and in field training by accompanying international experts during project missions	BTIC experts learn e.g. by supporting international experts in their activities	Sample feasibility study report prepared	Coordinator, Energy Engineer, Business Dev. Manager	900
		1.2.3. Provision of a 5-day training to BTIC staff by a contracted biogas center from neighboring country	BTIC experts learn about biogas technology, as well as the awareness and training activities to promote biogas systems	BTIC submits a report highlighting the learning that is relevant for Cambodia	2 experts from contracted biogas center	
1.3	Network with other biogas centers, researchers, project developers and suppliers of biogas system in the region created	1.3.1. Organization of a study tour for 4 BTIC experts to meet the different stakeholders and learn about biogas development in another country	BTIC experts meet and learn from the key players promoting biogas power technologies	Report on neighboring country's policy, regulations and incentive mechanisms as well stakeholders' analysis	Coordinator, Energy Engineer, Business Dev. Manager, Assistant	3,000
		1.3.2. Study tour members share their experiences and learning with other BTIC members	Knowledge gained by BTIC experts from their study tour is shared with all the BTIC members	BTIC team prepares a document highlighting the learning for Cambodia	BTIC team	
		1.3.3. BTIC members join online discussions, trainings and networks for biogas development	BTIC engages itself actively to learn from existing biogas networks	BTIC team highlights its networking activities through its website	BTIC team	
1.4	Information gathered and database for promoting biogas system created	1.4.1. Gathering information by the BTIC team through review of literature	BTIC team filters through materials to finalize contents of the BTIC website	Report presenting the classification of materials according to their relevance	BTIC team	
		1.4.2. Undertaking survey by BTIC team to create a database of biogas stakeholders	Database structure is finalized and information from the survey is stored in the database	BTIC submits a simple database with sample data	Outreach and content manager, Assistant	

Phase	Outputs	Activities	Result	Source of verification	Human Resources	Budget (US\$)
1.5	Training and workshop materials developed and customized based on the available resources	1.5.1. Study materials shared by PMU, international experts and neighboring biogas center with BTIC members	Outlines of the information and training materials developed for (1) policy makers, (2) project developers, (3) banks and (4) farm owners	BTIC finalizes the contents of awareness sessions, training and workshop	Coordinator, animal production specialist, energy engineer, business development manager, assistant	500
		1.5.2. Using the available materials, development of training and workshop materials by BTIC experts and customization to suit the context of Cambodia.	BTIC develops customized training and workshop materials.	BTIC finalizes customized training and workshop materials for use during the incubation phase	Coordinator, animal production specialist, energy engineer, business development manager, assistant	1,000
1.6	Brochures/leaflets prepared and website developed	1.6.1. BTIC team prepares promotional leaflet with support from PMU.	Promotional materials are finalized for circulation	Promotional materials shared with the PMU.	Coordinator, Outreach and content manager, Assistant	200
		1.6.2. BTIC studies existing biogas related web sites to develop one that is specific to the project activities in Cambodia.	BTIC develops the preliminary contents of the website presenting the objective, role and action plan	Website is available for public access	Website technician	200
1.7	Public announcement made and media campaign launched to publicize BTIC services	1.7.1. With support from PMU, BTIC makes public announcement and media campaigns to publicize BTIC services	Materials are finalized for public announcement and media campaigns	Announcements made through national public media	Coordinator, Outreach and content manager	500

Each of these activities is described below with more details:

1. **Set up BTIC office.** Following the signing of MoU/LoA between UNIDO and RUA, RUA will mobilize qualified personnel to create the BTIC team by taking into consideration the profiles of the experts needed and the need to make gender-sensitive appointments. Once the coordinator and the assistant have been appointed, they will coordinate with the PMU to acquire the hardware necessary for the functioning of the BTIC.

Once the personnel have been appointed to their respective positions, PMU will present the work plan to the BTIC team to ensure that each member of the team understands well the role of BTIC and the activities that will be carried out by the BTIC team members. If needed, they will discuss to revise and finalize the work plan that will serve as the official guide for implementing BTIC activities following the suggested 3 phases.

2. **“Train the trainers” and “Train the experts”.** Support will be provided to the BTIC team with the expertise needed so that their capacity is strengthened to provide the various services that BTIC is expected to offer. The project may envisage a series of “train the trainer” and “train the expert” activities by adopting different strategies.

Training sessions will be organized for the BTIC team to improve the knowledge on biogas technology. This can be conducted with a combination of various options: classroom lectures and discussion, field training, internship with another existing center in the region and study tour. The classroom lectures and discussion may be structured with the assistance of experts from the region who already operate information and training center like the one planned for BTIC. This could be a combination of training in Cambodia as well as study visit to suitable regional institutions so that the BTIC team gets an exposure to the concrete activities being taken to promote biogas systems.

By the end of the start-up phase, the training received by the BTIC team should allow them to achieve the following:

- a. Biogas production and GHG reduction potential assessed;
- b. The methodology to assess the energy demand of the farm and biogas system sizing and optimization developed;
- c. Technologies, operation and maintenance of biogas system understood;
- d. Sample feasibility study on biogas power plant conducted;
- e. The needs for and the types of policy, regulation and incentives for the development of biogas power grasped;
- f. Further training needs at the advance level identified
- g. Sample bankable biogas project proposal developed; and
- h. Business models, business plans and sustainability of business incubators studied and understood⁷.

⁷Facility established to nurture young (startup) firms during their early months or years. It usually provides affordable space, shared offices and services, hand-on management training, marketing support and, often, access to some form of financing (Read more at: <http://www.businessdictionary.com/definition/business-incubator.html>).

The BTIC should serve as a knowledge hub for project development. The expected outputs to fulfill this objective are listed below:

- a. Feasibility study guideline, tools or template developed;
- b. Financial gaps of the commercial biogas power plant projects assessed; and
- c. Viability criteria for the setting up biogas power plant in potential animal farms developed.

The course curriculum, conducted during 5 days, should consist of:

- a. Assessing potential biogas production and potential GHG emission reductions;
- b. Assessing on farm energy demand and biogas system sizing and optimization;
- c. Studying the different biogas technologies (gas treatment options and effectiveness);
- d. Operation and maintenance of biogas systems (including online monitoring of gas production, electricity generation and usage, occupational health and safety issues);
- e. Conducting feasibility studies of a biogas project;
- f. Reviewing policy, regulations and incentives for biogas power development; and
- g. Developing bankable financial proposal.

The exact content of the training will be prepared by the biogas center from the region contracted to undertake “train the trainer” activities in 2 phases: training in Cambodia and training in the country of the host biogas center.

The best way to achieve knowledge and practical experience is the involvement of the BTIC team in the on-going project activities in an active manner. The project will be mobilizing international expertise to carry out specific tasks. This should provide the right occasion to transfer the know-how from international experts to the BTIC team by creating a mechanism that allows the BTIC team to collaborate with international experts not only to learn but also contribute to the tasks assigned to the international experts.

3. **Create an active network with relevant centers, universities or institutes, researchers, and technology suppliers.** The networking will help BTIC to learn from the experience of other similar centers in the region or other parts of the world. The networking can help in transferring biogas technology knowledge, technologies and training to BTIC. As mentioned, *the same biogas center contracted for conducting training in Cambodia should be assigned the task of organizing a 5-day study tour* to familiarize selected BTIC team members with the overall environment created for promoting biogas development, including meetings with various groups of stakeholders, as well as field visits to interact with the animal farms that are operating biogas power system successfully for several years. Upon returning to Cambodia, the Cambodian delegation will share the knowledge with the rest of the BTIC team members and prepare an action plan based on the learning during the study tour.
4. **Gather information and create database for promoting biogas systems:** BTIC team will filter through all the information available from various sources to finalize the contents of the website after conducting a gap analysis and identifying those subjects that are more relevant in the Cambodian context. The structure of the database will be finalized so that the information gathered from surveys conducted will be stored in a manner that is easily accessible to all through the website. The database would include the details of the different

stakeholders as well as their contact details, preferably accessible on a map. The database will also show the animal farms that have already installed biogas power systems as well as those which have already completed a feasibility study so that any financial institution which shows interest in lending them can easily find their details.

5. **Develop and customize awareness programs, training sessions and workshops:** The training courses and workshops will be programmed based on stakeholders' (policy makers, bankers, RE/technical institutions and O&M companies) requirements. As stated in the project document, the capacity of policy makers and the different target groups will be assessed to customize the awareness and training materials accordingly. The training course may include classroom sessions, field visits, self-learning, etc. The training materials could be made available through BTIC website for ease of access by the trainees. The training and capacity building programs of BTIC for the different stakeholders are listed in Table 3.

The BTIC team will apply the knowledge from "Train the trainers" to develop a **biogas power plant learning center**. The virtual learning facility will be developed and used as a training center of BTIC to expand the biogas technology knowledge. The details of the activities could include:

- a. Feasibility study for medium or large scale biogas projects;
- b. Design and implement biogas power plants;
- c. Train farm owners to operate and maintain biogas power plants.

Table 3. Training and capacity building programs to be developed by BTIC⁸

Key stakeholders	No. of participants/ session	Training course	Formats ⁹	Duration (approximate)	Training fee ¹⁰	Example from other centers
Policy Makers	15-20	1. Policy and regulation related to renewable energies, with focus on biogas power	Workshop	½ day	100% project support	http://goo.gl/Rai0Hg http://goo.gl/k1H5De
Project developers and technical experts	15-20	1. Detailed biogas plant design for the demonstration sites	Training, field visit	2 days	80% project support 20% Trainee support	
	15-20	2. Necessary licenses, permits and contracts for biogas power plants	Training, field visit	1 day	80% project support 20% Trainee support	
	15-20	3. Preparing bidding documents for biogas power plants	Training	2 days	80% project support 20% Trainee support	
	15-20	4. Financial feasibility study of biogas power plants	Training	2 days	80% project support 20% Trainee support	
Farms and agro-industry owners	15-20	1. Criteria for the development of model animal farm	Training	3 days	100% project support	
	15-20	2. Management of waste in animal farms and energy generation for productive uses	Training	3 days	100% project support	
	15-20	3. Animal production and veterinarian prevention services	Training	1 day	100% project support	
	15-20	4. Good operation and maintenance practices of bio-digesters and biogas power facility	Training	1 day	100% project support	
Banks, financial institutions and funding agencies	15-20	1. Bankable proposals for biogas plants in animal farms and risk management strategies	Workshop	1 day	50% project support, 50% participants	
	15-20	2. Modalities and procedures for availing soft loan to set up biogas power project in animal farms	Workshop	1 day	50% project support, 50% participants	
All stakeholders	More than 100	1. National conference and exhibition to share the results of the project with stakeholders and discuss about future developments	Conference	1 day	50% project support; 50% participants and exhibitors	

⁸ See Annex 2 for some examples of available biogas training courses.

⁹ Capacity can be built using various formats, depending on the category of participants and the depth of knowledge to be transferred. The formats that may be used at the BTIC are explained below:

Training: A very intense and dedicated learning session with a highly specific focus. Participants may be required to do exercises and participate in quiz/examination to test their understanding of the specific subject of training

Workshop: The participants will be expected to involve themselves in activities such as group discussion rather than passively listening to the lecture.

Conference: The meeting where the persons attend to learn from one another. All conferences typically feature presentation briefings.

Field visit: Trip to a site that is directly relevant to the training, workshop or conference.

¹⁰ The exact training costs will depend on many factors. This column recommends who should be supporter for the training fee, and it can be changed as appropriate.

In this phase, it is not necessary to set up an on-site medium or large biogas power project but the BTIC should be able to develop physical models and audio-visual tools to showcase the overall system that can help farmers to develop, operate and manage the animal waste for economic, social and environmental benefits.

Fortunately, this is now possible with limited resources thanks to the availability of hundreds of interesting audio-visuals on the subject uploaded on the internet by experts and practitioners around the world (some examples are given in Table 4).

Table 4. Information that may be available on the BTIC website

Key stakeholder	Content	Source of information	Format	Example from other centers
All stakeholders	1. What is biogas?	BTIC team Youtube	- VDO - Info graphic	http://goo.gl/aPZRA8
	2. How does the biogas system work?		- VDO - Infographics	https://youtu.be/3UafRz3QeO8 https://youtu.be/xy1EIXIS1JQ
	3. General benefits from the biogas system		- VDO - Info graphics	http://goo.gl/aPZRA8 https://youtu.be/n_dzjtCAa4
	4. Biogas plants location		- Map	http://goo.gl/5uMMkA
	5. BTIC News update		- Articles	http://goo.gl/JuJboS http://goo.gl/mHctTR
Farm owners	1. Benefit of biogas system to farm owners	BTIC team Youtube	- VDO	
	2. Profit from biogas power generation		- VDO	
	3. Requirements for farms that are well suited to install biogas system for electricity generation		- Info graphics - Checklist	http://goo.gl/iiQfzQ
	4. Source of fund		- Name list	
	5. O&M		- VDO - Operating procedure	https://goo.gl/UWWDve
Policy makers	1. Law and regulation related to biogas power generation, renewable energy, etc.	Other centers	- Articles - Info graphics	https://goo.gl/9hhkjc
	2. Best practice on policy and regulation related to renewable energy from other countries		- Articles - Info graphics	
	3. case studies, showing real biogas implementations and how legal framework impacts them.	Other centers	- VDO - Articles	
Local Engineering & O&M companies	1. Biogas technologies	BTIC team Youtube	- VDO - Articles	http://goo.gl/aPZRA8 https://youtu.be/6ZM1kYpWpZo
	2. Technology for selling excess electricity to the grid		- VDO - Articles	https://youtu.be/WLbo9Jr9pBY
Financial institutions	1. Available soft loan for biogas projects	Financial institution network	- Articles - E-brochure	https://goo.gl/xRmDu0
Regional and international institutions; IOs, bilateral and multilateral agencies	1. success story on biogas in country	BTIC team	- E-brochure	https://goo.gl/Ra1AiU
	2. Publication from BTIC		- Report	
	3. Area of biogas research		- Info graphics	
Education and other research institutions	1. Publication from BTIC	BTIC team	- Reports - Articles	https://goo.gl/VBhfht
	2. Training course offer		- Calendar	

3.3. The incubation phase (18 months)

3.3.1. Objective of the incubation phase

This is the phase in which a high level of handholding by the project will be required while the BTIC puts into practice the knowledge gained through training and networking. While the start-up phase assists in transferring initial knowledge and expertise; the BTIC will still require further assistance during the incubation-phase to build up sufficient expertise that allows them to disseminate the knowledge and expertise gained. This holds true for two reasons:

- To ensure that the quality of delivery matches with the project goal; and
- To impart confidence to the BTIC so that it can carry out the tasks smoothly beyond the incubation period to ensure sustainability of the BTIC.

In this phase, international experts mobilized by the project will support and supervise the activities of BTIC and will provide corrective measures in cases where BTIC is unable to achieve satisfactory results.

Objectives of the incubation phase may include the following:

1. **Sharing information and transferring knowledge** on biogas power generation to the key stakeholders (policy makers, farm owners, local engineers and O&M companies, banks and financial institutions) through BTIC website, training, workshop and field visits;
2. **Providing a basis for policy, regulations and incentives** related to biogas power generation by sensitizing the public decision makers on existing policies and regulatory frameworks as well as incentives in other countries;
3. **Assisting potential project developers in preparing viable biogas power generation proposals** and helping them find potential financing agencies;
4. **Developing business models**, and defining long-run activities that can ensure sustainability of the BTIC; and
5. **Networking with all stakeholders**, particularly with other biogas centers in the region.

BTIC is expected to achieve the following in the incubation phase:

1. Policy makers are sensitized about the policy, regulatory framework and incentives to help them make strategic decisions (favorable regulations and incentives) for supporting biogas based power
2. Public and private project developers and technical experts are trained on conducting feasibility studies to assess the viability of farm-based biogas power systems
3. Farms and agro-industry owners as well as personnel from local engineering companies are trained on the development and operation of biogas power systems
4. Banks and financial institutions are exposed to the business models and incentives for financing biogas power projects
5. Advisory services are provided for the development of bankable biogas power proposals
6. New curriculum on the development and usage of biogas power for productive uses in rural areas are developed and introduced in the university educational program
7. Updated information on all aspects related to biogas power from farm waste is accessible through BTIC website

8. Network with biogas centers from the region is established and up-to-date list of all key stakeholders of the biogas power network is accessible from BTIC website
9. A biogas conference-and-exhibition is organized to present the results of the project to all key stakeholders, discuss the future development of biogas power in Cambodia and help match-making between technology providers and their potential clients

3.3.2. Key activities of the incubation phase

As outlined in Figure 4, the key activities of the incubation phase include designing, developing and conducting training courses and workshops, gathering and sharing information, undertaking advisory and consulting activities, proposing innovative financing mechanism to render biogas power projects financially more attractive, and ensuring that the project meets the biogas power generation target.

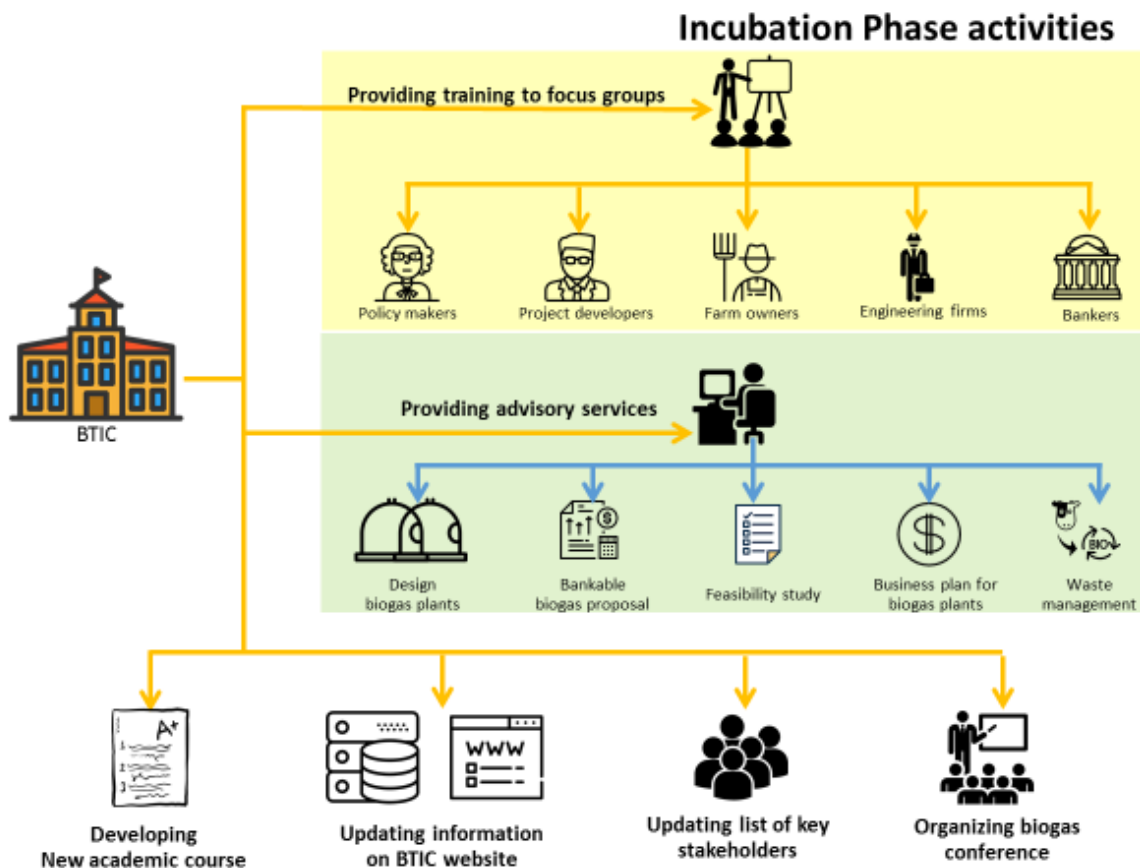


Figure 4. Proposed activities during the incubation phase

Table 5 provides a summary of activities, expected results, sources of indicators, human resources to be mobilized and an indicative budget for conducting the activities.

Table 5. Detailed description of the incubation phase (Phase 2) with indicative budget

Phase	Outputs	Activities	Result	Source of verification	Human Resources	Budget (US\$)
2.1	Policy makers are sensitized about policy, regulatory framework and incentives	2.1.1. A gap analysis is conducted to identify the policy, regulatory and incentive measures that may suit Cambodian context	A policy, regulatory and incentive study report is finalized	Policy, regulatory and incentive gap analysis report	Coordinator, Local Consultant	1,000
		2.1.2. At least 3 awareness and sensitization workshops aimed at public decision makers are organized (Each workshop of ½ day, every 6 months, for 15-20 participants)	Workshop reports summarize the feedback from the public decision makers	Workshop reports	Coordinator, BTIC Trainers, International Consultant, Assistant	1,500 (500 x 3)
2.2	Project developers and technical experts are trained on the feasibility of farm-based biogas power system development	2.2.1. At least 3 hands-on training sessions are organized on detailed plant designs for the demonstration site (Each training session of 2 days including field visit, every 6 months, for 15-20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant, Assistant	2,400 (80% of 1,000 x 3)
		2.2.2. At least 3 hands-on training sessions are organized on necessary licenses, permits and contracts for biogas plants (Each training session of 1 day, every 6 months, for 15-20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	1,200 (80% of 500 x 3)
		2.2.3. At least 3 hands-on training sessions are organized on preparing bidding documents for biogas plants (Each training session of 1 day, every 6 months, for 15-20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	1,200 (80% of 500 x 3)
		2.2.4. At least 3 hands-on training sessions are organized on financial feasibility study of biogas plants (Each training session of 2 days, every 6 months, for 15-20 participants)	Training reports are prepared including sample bankable proposal developed by participants	Training reports and bankable proposals	BTIC Trainers, International Consultant	2,400 (80% of 1,000 x 3)
2.3	Farms and agro-industry owners as well as personnel from local engineering companies are trained on the development and operation of biogas power systems	2.3.1. At least 3 training sessions are organized on the criteria for the development of model animal farms that include biogas systems: Each training session of 3 days, every 6 months, for 15 to 20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant, Assistant	3,600 (80% of 1,500 x 3)
		2.3.2. At least 3 training sessions are organized on management of waste in an animal farm and energy generation for productive uses (Each training session of 3 days, every 6 months, for 15 to 20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	3,600 (80% of 1,500 x 3)
		2.3.3. At least 3 training sessions are organized on animal production and veterinarian prevention services (Each training session of 1 day, every 6 months, for 15-20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	1,200 (80% of 500 x 3)

Phase	Outputs	Activities	Result	Source of verification	Human Resources	Budget (US\$)
		2.3.4. At least 3 training sessions are organized for technicians on good O&M practices of bio-digesters and biogas power facilities (Each training session of 1 day, every 6 months, for 15-20 participants)	Training reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	1,200 (80% of 500 x 3)
2.4	Banks and financial institutions are exposed to the business models and incentives for financing biogas power projects	2.4.1. At least 3 workshops are organized on bankable proposals for biogas plants in animal farms and risk management strategies (Each training session of 1 day including ½ day field visit, every 6 months, for 15-20 participants)	Workshop reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant	1,500 (50% of 1,000 x 3)
		2.4.2. At least 3 hands-on workshops are organized on modalities and procedures for availing soft loans to set up biogas power projects in animal farms (Each workshop of 1 day including ½ day field visit, every 6 months, for 15-20 participants)	Workshop reports are prepared including participants' feedbacks	Training reports	BTIC Trainers, International Consultant, Foreign Trade Bank of Cambodia (FTBC)	1,500 (50% of 1,000 x 3)
2.5	Advisory services provided for the development of bankable biogas proposals	2.5.1. Upon requests received (for instance from project developers and technical experts) assistance is provided for the development of bankable biogas proposal	Bankable proposal reports submitted to financial institutions for getting loan	Bankable proposal reports	Business Development Team	2,000 (Provision)
2.6	New academic course developed and introduced in the university curriculum	2.6.1. A new academic course on the development of biogas power for productive uses in rural areas developed and submitted for approval by the Academic Senate	The new academic course submitted and approved by the Academic Senate	Approved course outline	Coordinator and BTIC members	1,000
		2.6.2. The course is taught to the undergraduate students specializing in animal farm management	Course materials are compiled and made available on BTIC website	Course materials and feedbacks from students	The lead instructor	1,000 (500 x 2)
2.7	Updated information on biogas power from farm waste is accessible through BTIC website	2.7.1. Information targeting the different stakeholders of biogas power from farm waste is regularly updated at BTIC website	Briefings of the monthly updates sent through electronic media to all registered website members	Briefings of the monthly website updates	Outreach and contents manager, website technician	1,500
2.8	Up-to-date list of all key stakeholders of the biogas power network is accessible from BTIC website	2.8.1. Network with biogas centers from the region is established and a database of all key stakeholders is developed along with some basic information on them and is updated as and when new information is available	Database of the key stakeholders of the biogas power network in and outside Cambodia	Database available on BTIC website	Outreach and contents manager, website technician	500
2.9	A biogas conference & exhibition is organized	2.9.1. A national conference & exhibition is organized to share the results of the project with stakeholders and discuss about future development	The conference provides a forum for all key stakeholders to celebrate success and discuss sustainability issues	Conference proceedings	Coordinator, BTIC team with support from PMU	2,000

Each of these activities is described below with more details:

1. **Policy makers are sensitized about regulatory framework and incentives.** A suitable policy and regulation is an important mechanism to allow for and accelerate biogas power development in Cambodia. After setting up the BTIC center, a gap analysis of the policy, regulatory and incentive measures can be conducted by the BTIC team to identify opportunities that may suit the Cambodian context. Based on the gap analysis outcome, awareness and sensitization workshops shall be organized for public decision makers. The length of workshops should be half a day, and the number of participants should be limited to 15-20 persons. There are three workshops to be conducted during the incubation phase, one every 6 months. At the end of the incubation phase at least 50 policy makers should be trained by the BTIC.
2. **Project developers and technical experts are trained on the feasibility of farm based biogas power system development.** Developing biogas power plants requires both technical and financial skills of project developers and technical experts. The training on technical and financial aspects shall be provided to project developers, farm owners and technical experts to ensure that they can develop successful biogas plants in Cambodia. The training sessions could be split in the following four topics:
 - a. **Conducting detailed plant design for the demonstration site.** This course will provide technical knowledge on how to design biogas power plants. The 2-day training should be organized 3 times, once every 6 months, and involve 15-20 participants.
 - b. **Accessing necessary licenses, permits and contracts for biogas plants.** This course will make the participants become familiar with the required documents (license, permits and contracts) that are needed for establishing biogas plants. The 1-day session should be organized 3 times, once every 6 months, and involve 15-20 participants.
 - c. **Preparing bidding documents for biogas plants.** This course will help participants develop bidding documents that can be used for the bidding process for commissioning biogas plants. The 1-day session should be held 3 times, once every 6 months, and involve 15-20 participants.
 - d. **Assessing the financial feasibility of biogas plants.** Financial benefit is an essential element for biogas projects. This course will familiarize trainees with the method to conduct financial feasibility study of biogas plants. The 2-day training session should be conducted 3 times, once every 6 months, for 15-20 participants.

By the end of the incubation phase, at least 50 developers and technical experts are expected to have attended the training provided by BTIC.

3. **Farm and agroindustry owners as well as personnel from local engineering companies are trained on the development and operation of biogas power systems.** Good and reliable operation of biogas power plants requires stable biogas sources. Latter is is a result of good waste management, and good operation and maintenance (O&M). Therefore, farm owners are the key to reliable biogas power systems as they can control the source of biogas by operating efficiently the facility of the farm. The O&M personnel from local engineering firms

can help to run the biogas plants in good conditions. The training sessions that are suitable for such stakeholders include:

- a. **Understanding the criteria for the development of model animal farms that include biogas systems.** This course will provide an understanding of the minimum and optimum criteria of animal farms that are suitable for the development of biogas plants. Participants can determine if their farms are suitable for developing biogas systems and can learn how to develop farms to suit the required criteria. The session would consist of 2 days of training, held 3 times, once every 6 months, for 15-20 participants.
- b. **Management of waste in an animal farm and energy generation for productive uses.** Good waste management is key to guarantee reliable energy from biogas plants in steady operation. This training will provide knowledge on the waste management in an animal farm and basic calculation of energy generation from the waste. The 3-day training session should be conducted 3 times, once every 6 months, for 15-20 participants.
- c. **Organization of animal production and veterinarian prevention services.** The training will provide knowledge on systematic organization of animal production and veterinarian prevention services to the participants. This 1-day training session will be held 3 times, once every 6 months, for 15-20 participants.
- d. **Good operation and maintenance practices of bio-digesters and biogas power facilities.** The reliability of biogas plants depends on the good operation and maintenance of biogas systems. The training course aimed at technicians, both from farms as well as engineering companies, will provide the best practice to operate and maintain biogas facilities. Over a period of 18 months, the 1-day training session will be conducted once every 6 months, for 15-20 participants.

50 representatives from farms and agro-industry owners as well as personnel from local engineering companies are expected to be trained by the end of the incubation phase.

4. **Banks and financial institutions are exposed to the business models and incentives for financing biogas power plant projects.** Financial support plays an important role in biogas power plant projects, because biogas power plant projects require some incentives and risk management strategies to make them financially attractive. The following training programs can be provided to personnel of banks and financial institutions:
 - a. **Evaluating bankable proposals for biogas plants in animal farms and risk management strategies.** Banks and financial institutions would like to ensure that biogas projects can pay back the loan. Workshops will make the banks and financial institutions understand the business model of biogas plants in animal farms and risk management strategies to ensure that loans can be recovered from biogas projects. The 1-day workshop will be held 3 times, once every 6 months, for 15-20 participants.
 - b. **Understanding modalities and procedures for availing soft loans to set up biogas power project in an animal farm.** Biogas projects may require that specific soft loans are set up. The workshop will familiarize the participants with the modalities and procedures that can be applied for availing soft loans in the context of Cambodia. The 1-day workshop sessions (including half-day field visit) will be organized 3 times, once every 6 months, for 15-20 participants.

50 representatives from banks, financial institutions and funding agencies are expected to have attended the training by the end of the incubation phase.

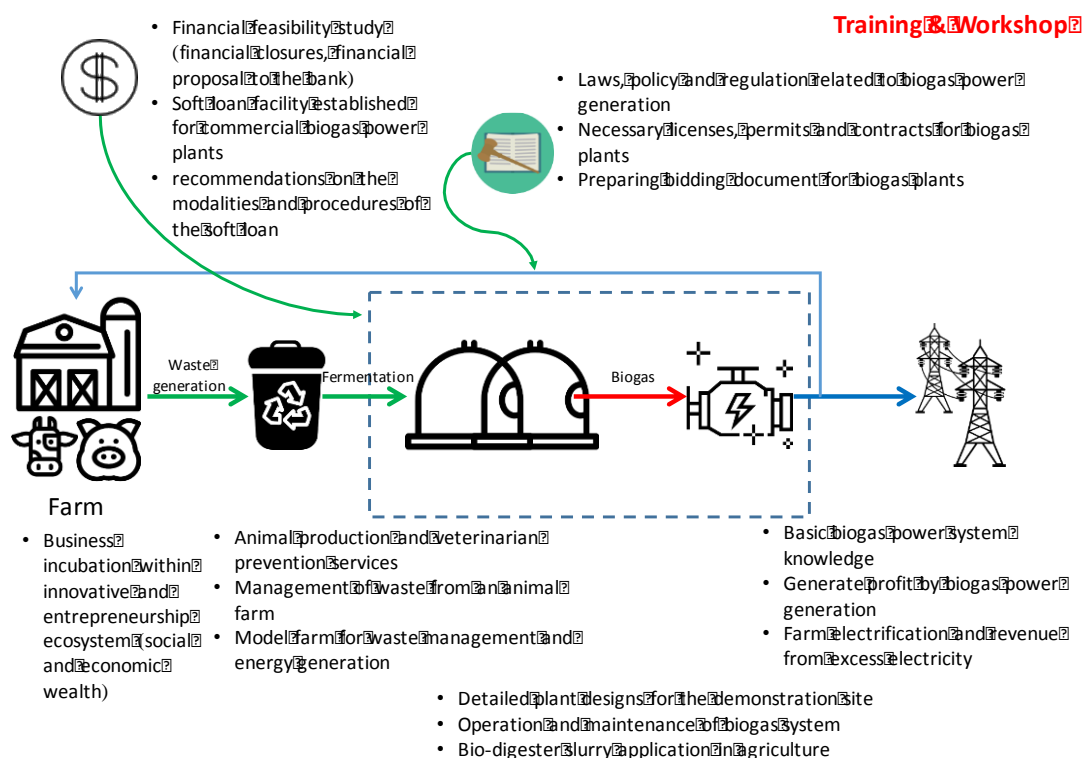


Figure 5. Activities related to training and capacity building (2.1-2.4)

5. **Advisory services provided for the development of bankable biogas proposals:** BTIC should be able to provide technical assistance for developing bankable proposals upon request of project developers and technical experts. The consulting services that BTIC may offer are presented in Table 6.

Table 6. BTIC's services in the form of technical assistance¹¹

Topic	Services
Business promotion	1. Helping farm owners to develop business plans and access credit
	2. Establishing a farmer cooperative
	3. Setting up business models and ensure business sustainability
	4. Providing knowledge and skills for entrepreneurs
	5. Developing biogas power plant proposals for accessing a loan
	6. Conducting economic feasibility studies
Technical assistance	1. Conducting technical report on feasibility to invest in biogas system
	2. Developing an early warning system through devices, applications and website
	3. Provide technical audits of existing biogas plants
	4. Designing and implementing biogas power plants
	5. Setting up devices/app application/ web page for biogas power plant systems

¹¹ The consulting services can be added in the future depending on the customer's requirements and BTIC's capability.

	6. Undertaking relevant R&D independently and in coordination with other academic/ research institutions and with the private sector.
	7. Providing technical support for renovation and modernization of existing biogas systems.
	8. Creating National laboratory for performance testing and certification.
	9. Carrying out environment (and social) impact assessments and eco-restoration studies
	10. Providing advice on adapting and formulating guidelines and standards for biogas power projects in Cambodia

6. **New academic course developed and introduced in the university curriculum.** Development of higher level academic course on biogas generation using farm waste is an effective way to ensure the sustainable knowledge transfer of biogas power in Cambodia. A new academic course on biogas power for productive uses in rural areas can be developed and submitted for approval to the Academic Senate. After the approval, the course should be taught to the undergraduate students specializing in animal farm management.

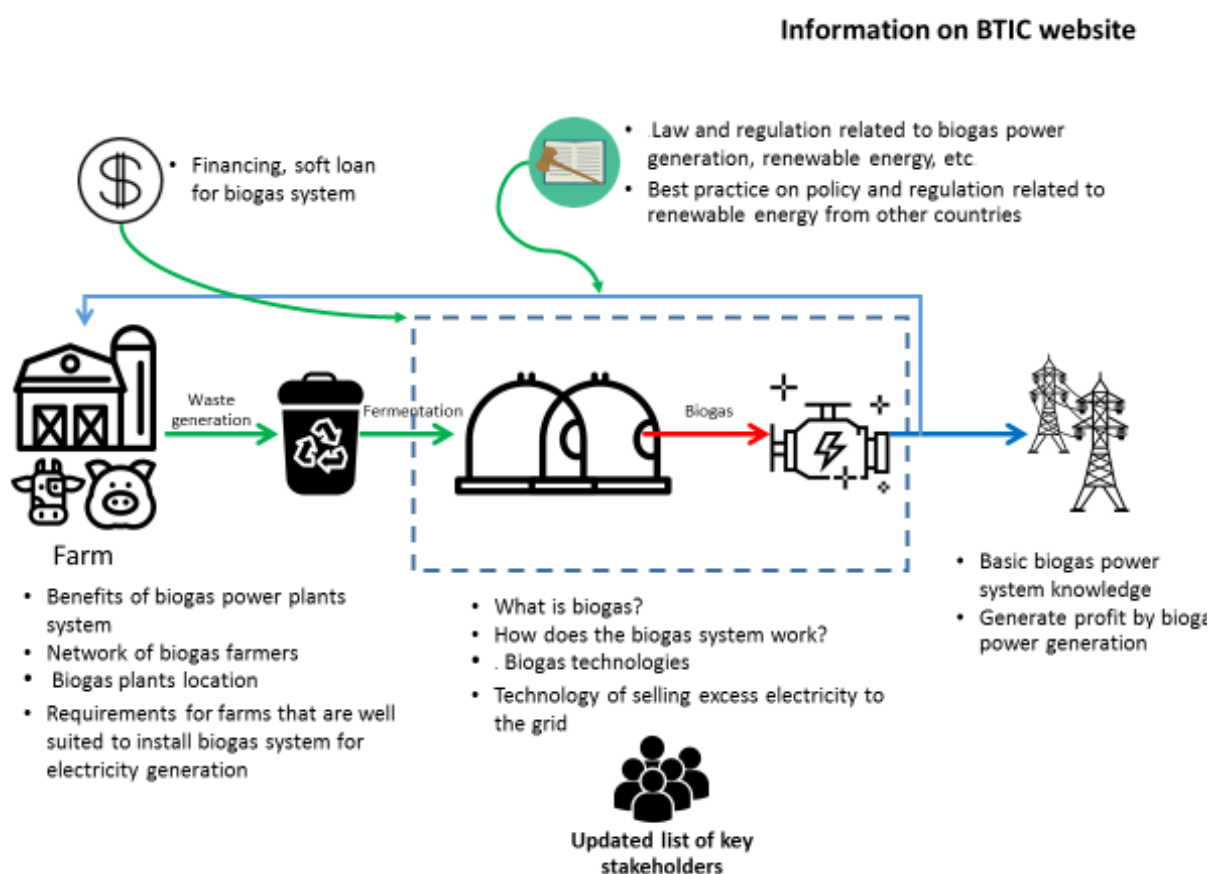


Figure 6: Expected information on BTIC website (2.7-2.8)

7. **Updated information on all aspects of biogas power from farm waste is accessible through BTIC website.** Updated information on biogas power from farm waste should be gathered and disseminated using an online database that is easily accessible through the BTIC website. Up-to-date information attracts the stakeholders to visit the website periodically to learn about all new aspects on the subject. Information can be made available in various forms such as articles, newsletters, videos, info-graphics, etc. that are easy for key stakeholders to understand. The BTIC website should be updated at least once a month.
8. **Up-to-date list of all key stakeholders of the biogas power network is accessible from BTIC website.** Collaboration and networking are key to the success of biogas power projects. Best practices and knowledge can be shared through BTIC by creating a network of key stakeholders in and outside Cambodia, particularly with biogas centers in the region. An updated database of all key stakeholders with some basic information on them can help to render the networking dynamic and fruitful.
9. **A biogas conference-&exhibition is organized.** The national biogas conference should be conducted by BTIC to present the results of the project to the stakeholders. Representatives from the biogas centers from the region should be invited to share their experience and brainstorming session held with them along with all national stakeholders to discuss about the future development of biogas power in Cambodia. The conference should provide a forum for all key stakeholders to celebrate success, share the lessons learned and best practices, and discuss sustainability issues.

[3.3.3. Expected outputs of the incubation phase](#)

The incubation phase is designed to be over a period of 1.5 years, to be completed by the final phase of the project. Following are the expected outputs of the incubation phase:

Training and workshop

Training and workshop organized by BTIC to benefit the following stakeholders:

- a. 50 policy makers on policy, regulatory framework and incentives (sharing of policies and regulations adopted elsewhere);
- b. 50 representatives from different technical institutions on feasibility of farm-based power system development and development of bankable biogas power system projects (advanced biogas power generation technologies, cost-benefit analysis, bankable proposals);
- c. 50 representatives from farms and agro-industry owners as well as personnel from local engineering companies on the development and operation of biogas power systems (technology, best operation and maintenance, preventive maintenance, scope for upgrading existing facilities); and
- d. 50 representatives from banks, financial institutions and funding agencies on business models and incentives for financing biogas power projects (innovative financing, mobilizing capital subsidy or green financing for biogas projects).

BTIC will ensure that both women and men are provided equal opportunities to participate in the training courses and workshops by promoting participation of women both at the technical and managerial level. The training and capacity building activities will be announced to companies and

organizations, encouraging them to nominate women staff so that at least 20% of women participants are represented in each training event.

Advisory service

Advisory services provided by BTIC to key stakeholders, as and when requested. Some suggested advisory services to fulfill this objective include:

- a. Developing bankable biogas proposals
- b. Developing business plan and access credit for farm owners;
- c. Establishing farmer cooperatives;
- d. Technical report on feasibility to invest in biogas system;
- e. Assessing of existing facilities to explore the potential to enhance biogas power generation;
- f. Setting up business models and sustainability of business incubators, etc.

New academic course

A new academic course designed by BTIC on the development of biogas power for productive uses in rural areas and approved by the Academic Senate. After approval, the course is taught to undergraduate student specializing in animal farm management.

Update information

Monthly updated information as well as updated list of all key stakeholders are available on BTIC website.

Networking

A network with biogas centers in the region will be established and up-to-date information of the key stakeholders of the network will be shared on BTIC website.

Biogas power conference

The national biogas power conference for all key stakeholders is organized by BTIC. Representatives from biogas centers from the region are invited to participate in the brainstorming session during the conference to share their experience and provide guidance on the future development biogas in Cambodia. The suggested agenda of the conference may be as listed below:

- a. Sharing the results of the biogas power projects
- b. Sharing best practice, lesson learn from the biogas projects
- c. Discussing about future development

3.3.4. Work plan of the incubation phase

Activity	Month																													
	Start-up phase						Incubation phase																		Sustainability phase					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Incubation phase outputs																														

Activity	Month																													
	Start-up phase						Incubation phase																		Sustainability phase					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
2.1.1. A gap analysis is conducted to identify the policy, regulatory and incentives that suit Cambodian context																														
2.1.2. At least 3 awareness and sensitization workshops aimed at public decision makers are organized																														
2.2.1. At least 3 hands-on training sessions are organized on detailed plant designs for the demonstration site																														
2.2.2. At least 3 hands-on training sessions are organized on necessary licenses, permits and contracts for biogas plants																														
2.2.3. At least 3 hands-on training sessions are organized on preparing bidding documents for biogas plants																														
2.2.4. At least 3 hands-on training sessions are organized on financial feasibility study of biogas plants																														
2.3.1. At least 3 training sessions are organized on the criteria for the development of model animal farms that include biogas systems																														
2.3.2. At least 3 training sessions are organized on management of waste in an animal farm and energy generation for productive uses																														
2.3.3. At least 3 training sessions are organized on animal production and veterinarian prevention services																														
2.3.4. At least 3 training sessions are organized for technicians on good O&M practices of biogas power facilities																														
2.4.1. At least 3 workshops are organized on bankable proposals for biogas plants in animal farms and risk management																														

Activity	Month																													
	Start-up phase						Incubation phase																		Sustainability phase					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
strategies																														
2.4.2. At least 3 hands-on workshops are organized on modalities and procedures for availing soft loans to set up biogas power projects in animal farms																														
2.5.1. Assistance is provided for the development of bankable biogas proposal (upon request from project developers and technical experts)																														
2.6.1. A new academic course on the development of biogas power for productive uses in rural areas developed and submitted for approval by the Academic Senate																														
2.6.2. The course is taught to the undergraduate students specializing in animal farm management																														
2.7.1. Information targeting the different stakeholders of biogas power from farm waste is regularly updated at BTIC website																														
2.8.1. Network with biogas centers from the region is established and a database of all key stakeholders is developed																														
2.9.1. A national conference-& exhibition is organized to share the results of the project with stakeholders and discuss about future development																														

[3.3.5. Expenses and revenues for the incubation phase](#)

Expenses in the Incubation phase are associated with the cost of gathering and disseminating information (through website, brochures, mobile phone, etc.), cost of developing and updating a database of stakeholders, cost of developing and conducting trainings and workshops, developing and implementing academic courses, cost of organizing a national conference-& exhibition of biogas

technology, and the cost of developing feasibility studies and bankable proposals on behalf of the farm owners.

On the other hand, the revenue during the incubation phase is expected mainly from two activities (training & workshop and consulting services).

1. **Training and workshop fees:** While the major share of the training cost will be covered by the project during the project life, the private beneficiaries should be asked to cover a small fee for participating in the training and capacity building programs so that they see the value in the training that is provided. This will help to encourage the stakeholders to participate in the training course more actively. This will also allow having the necessary budget to expand the biogas knowledge to stakeholders. As mentioned in Table 4, project developers and technical experts as well as farms and agro-industry owners will be expected to pay a nominal fee to raise about 20% of the total training and capacity building costs. On the other hand, banks and financial institutions will be expected to contribute up to 50% of the workshop costs that include field visits. Finally, private sector participants and biogas technology suppliers are expected to contribute and compliment the budget from the project for the proposed conference-&-exhibition. Please refer to the gender mainstreaming strategy to promote gender equality and empower women through trainings and workshops. For instance, while gender parity cannot be reached, t least 20% of the participants should be women. A special training discount for women should be available. Training materials should also be gender-sensitive.
2. **Consulting service fee:** BTIC may be involved in different types of advisory /consulting services as and when solicited by the developers or technical experts. The service/consulting fee should be adjusted to different types of services. Banks and financial institutions could cover the cost of bankable proposals that they accept to finance. They could include this cost as a part of their transactional cost and recover it along with the capital within a reasonable time frame that is agreed with the client.

3.3.6. Indicative Budget Requirements

Table 7 provides an indicative budget for BTIC start-up and incubation phase. This budget that should be supported by the project does not include the revenue generated by the BTIC from the partial training and workshop fees to be contributed by participants.

Table 7. Indicative budget for the BTIC start-up and incubation phase (2 years) in US\$

Indicative Budget Requirements	Start-Up Phase (6 months)	Incubation Phase (18 months)	Total (US\$)	% of total budget
BTIC created and efficiently managed	11,300		11,300	27.2%
Policy makers are sensitized about policy, legal and incentive frameworks to promote biogas investments and markets		2,500	2,500	6.0%
Capacities of the local developers and technical experts on various biogas aspects are strengthened and applied		7,200	7,200	17.3%

Capacities of the farm owners and agro-industry owners on various biogas aspects are strengthened and applied		9,600	9,600	23.1%
Capacities of the financial institutions on various biogas aspects are strengthened and applied		3,000	3,000	7.2%
Project developers are enabled to formulate bankable proposals for Investment in biogas infrastructure, services and businesses		2,000	2,000	4.8%
Academic curriculum developed and implemented		2,000	2,000	4.8%
Availability of investment and market data, awareness and advocacy on biogas are strengthened		2,000	2,000	4.8%
Conference-&-exhibition organized		2,000	2,000	6.0%
Total	11,300	31,300	41,600	100%

3.3.7. Funding Commitments and Fund Mobilization

The budget indicated in the previous section is based on what should be committed by the project to BTIC for undertaking the planned activities. Apart from the initial support from the project for the establishment of BTIC in the start-up phase, the project will not provide any funds for the BTIC for its day-to-day operation. Funds from the project will flow to BTIC during the incubation phase only based on activities performed and the results achieved. BTIC on its own is expected to generate funds by charging fees from training participants, as indicated in Table 3.

BIC will submit a proposal of activities and expected results on a half-yearly basis. The project will assess the proposal and release 75% of the funds within a month of receiving the proposal so that BTIC has the means to implement the planned activities. BTIC will submit a consolidated report every 6 months, highlighting the activities undertaken and the results achieved, as well as the action plan for the next 6 months. The project will assess the result and release the remaining 25% along with the advance of 75% for the next phase of activities within a month of receiving the half-yearly project report.

Further, BTIC may also request financial support from the government, particularly to initiate activities that are under the direct mandate of RUA, such as conducting analytical and field research on topics that address issues related to farm waste management, biogas generation and usage. Such activities will enhance the expertise of BTIC to improve the training component and share its expertise with project developers on fee-paying basis.

BTIC will also look for complementary funding/support from other organizations, including bilateral and multi-lateral development agencies, interested to support the promotion of farm-based biogas energy development in Cambodia. This could be in the form of submitting proposals or taking part in commercial bids.

3.4. The sustainability phase

3.4.1. Objective of the sustainability phase

During the period of project implementation, BTIC will strive to fulfil its responsibility of enhancing the capacity of policy makers, project developers and financial institutions so that they support the development of farm-based commercial biogas power.

However, the activities of BTIC beyond the project life will depend very much on the overall outcomes of the project. The project is expected to create the enabling environment so that public decision makers introduce conducive policies and farm owners and financial institutions support the development of commercial biogas technology. If the expected project outputs are achieved and outcomes fulfilled, then the role of BTIC becomes crucial after the end of the project to continue supporting the different stakeholders so that they in turn promote investment in biogas power for productive usage. It will also depend on how RUA can nurture and mobilize support for BTIC so that the latter is recognized as its flagship initiative, contributing to the vision and mission of RUA to become a leading agricultural institution of Cambodia and the region.

The outcomes of the Sustainability phase may include the following:

1. Training and workshop activities are improved and conducted on a regular basis;
2. Information is continuously updated and shared with key stakeholders;
3. Network with all key stakeholders and biogas centers in the region is further expanded and strengthened;
4. Research is undertaken for developing new biogas technologies and the contents and the quality of the RUA's academic program is improved thanks to the learning from the BTIC; and
5. The scope of BTIC activities is broadened from biogas power generation to other uses of biogas.

3.4.2. Key activities of the sustainability phase

As outlined in Figure 7, the key activities of the sustainability phase include maintaining and improving training and workshop activities, continuously acquiring, processing, storing and disseminating information to create greater awareness, maintaining and increasing the consulting services, researching and developing biogas technologies, and retaining biogas stakeholders networking. These activities are explained in more details below:

1. **Maintaining and improving training and workshop activities** In the long run, BTIC can fine-tune the training courses to satisfy the specific needs of the trainees. More appropriate training courses would help to improve the understanding and knowledge of the participants. Advanced courses with updated contents would also attract more people to participate in such training programs.
2. **Continuously acquiring, processing, storing and disseminating the information:** The BTIC shall keep the updated information in the website. The continuously updated information will encourage visitors to revisit the website to get more current information. If more people access the content of the website, they will be increasingly aware of the latest development related to biogas technology and application.

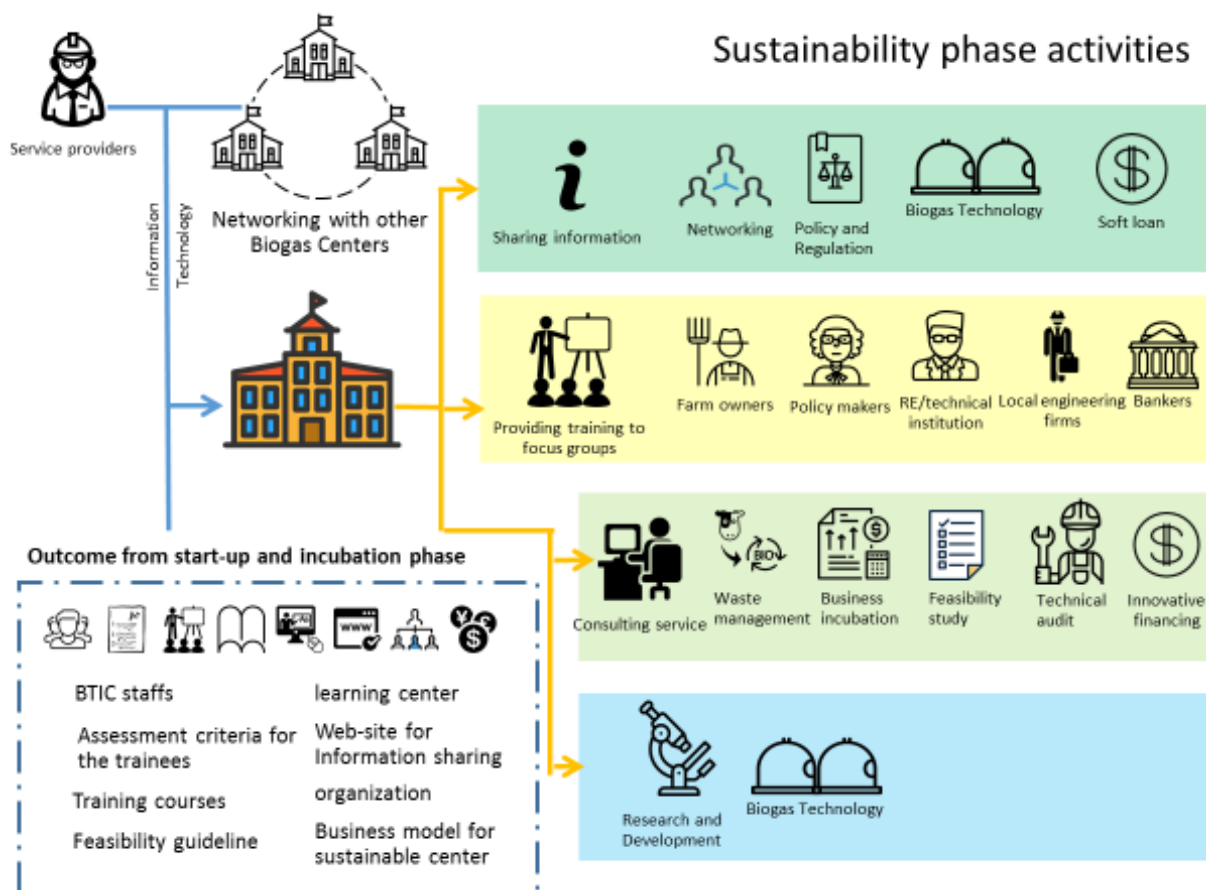


Figure 7. Proposed activities during the sustainability phase

3. **Maintaining and increasing the consulting services:** The customers have their own needs, so the consulting service should be flexible to meet various expectations. The flexibility adopted in providing service will enthruse farm owners to seek more service.
4. **Researching and developing biogas technologies:** Research and development activities will help to improve the biogas knowledge of the center. Research initiatives can lead to generation of new and indigenous biogas technologies that are more competitive than importing from elsewhere. This will also provide greater opportunity for hosting young students as interns and researcher. The suggested areas of research are highlighted in Table 8.

Table 8. Areas of research

No.	Research topics
1	Improved Biogas production technologies
2	Biogas slurry application in agriculture
3	Farm electrification
4	Management of waste from animal farms
5	Biogas market assessment and mapping
6	Identification of potential innovators and entrepreneurs

5. **Retaining and extending biogas stakeholders network:** The sustainability of BTIC requires a strong biogas network. The network can help in sharing knowledge, best practices or lessons learned. This will help to improve the capability to widen the application of biogas.

3.4.3. Expenses and revenues during the sustainability phase

Expenses of the sustainability phase are for carrying out the activities of the BTIC. The costs of sustainability phase may include research and development cost, cost for gathering and sharing information, cost for conducting training and workshop, cost for consulting service, cost for biogas stakeholders networking and overhead costs.

The above costs are elaborated in more details below:

1. **Cost of Conducting training and workshop:** Conducting training and workshop requires some costs such as training material, instructor payment, rental of meeting room, transportation cost for field visit, development of new training course content, etc.
2. **Cost of gathering and sharing information:** These are costs incurred to maintain and update information on the website, maintenance of the IT server, remuneration for IT technicians, cost to generate the new content information.
3. **Cost of consulting service:** Providing consulting service to customers also requires the cost for remunerating consultants.
4. **Research and development cost:** The cost of research and development is for equipping and running the laboratory, maintaining and purchasing experiments, organizing and participating in international conferences, developing publications, remunerating researchers, etc.
5. **Cost of maintaining biogas stakeholders networking:** The cost for maintaining the biogas stakeholders networking may include organizing conferences and meetings for the stakeholders, and running working groups.
6. **Overhead cost:** This cost includes rental of office, and other utility costs (electricity, water, telecommunication, maintenance, remuneration of administrative staff, etc).

Sufficient revenue should be generated for the sustainability phase to guarantee the smooth execution of the BTIC. The income of the BTIC in the sustainability phase may come from the following activities:

1. **Training fee:** The participants of the advanced training course should support the training cost in this phase. The government could support for instance the basic training course or could provide scholarships e.g. to women to promote gender balance. The BTIC can also provide free online training through the website.
2. **Consulting service fee:** This revenue model is the same as the incubation phase.
3. **Research and development budget:** The government should provide the fund for biogas research and development. The budget should not only support the operation of the center, but also for widely disseminating the biogas knowledge. The center could also seek finance from research programmes offered by the government, ASEAN region, or international organisations.

4. **Funding from bilateral and multilateral agencies:** BTIC should bid for projects announced by bilateral or multilateral agencies and submit proposals for funding specific activities that contribute to national and global environmental targets.

4. ACKNOWLEDGEMENTS

4.1. Icons in Figures

All icons used the figures are from www.flaticon.com

Annex 1 - Roles and Responsibilities of Specialized personnel of BTIC

1. BTIC Facilitator

The Facilitator shall expect to perform following duties and responsibilities:

- Establish and mobilize both human and financial resources for the work teams. Select personnel of the right profile according to the nature of the project;
- Perform criticality and/or lost opportunities analyses;
- Prepare an inventory of the systems or opportunities to analyze;
- Prepare an implementation plan for the techniques to be used;
- Prepare the activity schedule. The nature of this schedule depends on the team, and limits/needs of the team;
- Prepare a contingency plan to avoid any delays due to foreseeable events, i.e. vacation, sickness of the team member;
- Track the implementation and its results.

Following qualifications should be considered/met:

- Having considerable experience in project management and root cause analysis;
- Strong communication, negotiation and conflict solving skills;
- Demonstrate leadership in planning and control skills (issue/risk management, task management);
- Bachelor in development, economics, or applicable fields;

2. Biogas specialist

The Biogas specialist shall expect to perform following duties and responsibilities:

- Assessing the status of the existing biogas plants and preparing a technical advisory report for optimum utilization of the biogas plants;
- Assist the Intl expert to conduct Techno-economic Feasibility Studies including identification of appropriate technologies and best uses of biogas produced;
- Assist in identifying other appropriate uses;
- Providing input for development of bankable proposals;
- Providing inputs for development of practical biogas handbook in Khmer;
- Leading in training to local engineers and O&M technicians on biogas production side
- Assess mitigation potential achieved from the biogas plants;
- Perform other tasks if deemed or requested by the Facilitators;

Following qualifications should be considered/met:

- Proven understanding of biogas technologies and its applications in medium and large scale animal farms or using animal manure as feedstock.
- Previous experience on waste-to-energy technology and its impacts on climate change.
- Previous involvement of the expert in complex assignments with a similar scope and focus.
- Experience and familiarity in cooperative management at local level.
- Previous working experience with International Organizations or other development partners in biogas related project such as NBP (National Biodigester Program) is a definite advantage;
- Experience in delivering hands-on training;
- Bachelor in animal science, environmental science or applicable fields;

3. Electrical/energy engineer

The Electrical/energy engineer shall expect to perform following duties and responsibilities:

- Lead in assessing energy demand and system sizing and optimization;
- Lead in advising system inspection and O&M aspect of biogas unit;
- Leading in training to local engineers and O&M technicians on biogas utilization side;
- Providing input for development of bankable proposals;
- Providing inputs for development of practical biogas handbook in Khmer;
- Assess mitigation potential achieved from the biogas plants;
- Perform other tasks if deemed or requested by the Facilitators;

Following qualifications should be considered/met:

- Proven understanding of biogas technologies and its applications in medium and large scale animal farms or using animal manure as feedstock;
- Previous experience on waste-to-energy technology and its impacts on climate change;
- Experience in delivering hands-on training;
- Bachelor in electrical/energy engineering or applicable fields.

4. Business development

The Business development shall expect to perform following duties and responsibilities:

- With inputs from Biogas specialist and electrical/energy engineer, develop bankable biogas project for review and approval by farm owners or other project developers;
- Explain project developers about investment figures and implications on their financial situation;
- Providing inputs for development of practical biogas handbook in Khmer;
- Assess mitigation potential achieved from the biogas plants;
- Perform other tasks if deemed or requested by the Facilitators;

Following qualifications should be considered/met:

- Bachelor's degree in business, management, economics, finance or related field required; advanced degree preferred;
- Minimum five years of relevant technical experience supporting private and or/ public organizations to improve business development services for MSMEs in Cambodia, including a range of approaches and services;
- Experience working with multi-disciplinary and multinational teams;
- Familiarity and experience with international development principles and practices;
- English fluency required.

5. Outreach and content management

The Outreach and content management specialist shall expect to perform following duties and responsibilities:

- coordinate and facilitate outreach activities and web-based promotion efforts with support from website technician;
- Provide assistance and leadership in the areas of outreach and marketing to other specialized personals or BTIC;
- develop and implement social media strategy and oversees the development of webinars and videos;
- Perform other tasks if deemed or requested by the Facilitators;

Following qualifications should be considered/met:

- Bachelor's degree in communications, marketing, public administration, media-related field and one year directly related work experience. Will consider other degrees with applicable work experience;
- Good command of writing English and Khmer
- Must have good interpersonal and communication skills;
- High quality customer service, outreach and marketing skills;
- Strong, analytical problem solving, decision-making, and leadership skills.
- Candidate must have direct experience in public speaking and making successful presentations to diverse audiences.
- Excellent writing skills, with demonstrated ability to write for the web.
- Experience or training with social media strategy.
- Demonstrated ability to take initiative and be self-directed.
- Ability to travel occasionally to national or regional meetings.

6. Website technician

The Website technician shall expect to perform following duties and responsibilities:

- Updating and maintaining BTIC website (both English and Khmer) and databases;
- Working with Outreach and content management specialist, provide technical support on social media;

Following qualifications should be considered/met:

- Proven experience in website development or content/database management;
- Good command of English and Khmer (writing)
- Bachelor in IT

7. Assistant

The Assistant shall expect to perform following duties and responsibilities:

- answer customer inquiries and refer customers to the proper service area for issues that cannot be resolved at the teller line;
- provide support and creates balance in the time and scope of executing tasks under the direct supervision of the BTIC Facilitator and other experts;
- carry out administrative duties by collecting data, sorting, filing and sending out project files to the right personnel, workers, and stakeholders;
- maintains the highest level of confidentiality with all information obtained;

Following qualifications should be considered/met:

- *Excellent customer service skills, attentiveness, information retention, tact and diplomacy in dealing with both customers and BTIC;*
- *Strong communication & organizational skills.*
- *Detail oriented, high degree of accuracy;*
- *Competence with computers, telephone, and other office machinery.*
- *Ability to work in a fast-paced environment & under pressure as needed*

Annex 2 – Examples of available biogas training courses

Training	Duration	Topics	Teaching method	Price	Reference
Agro- Industrial Biogas Training Seminar	2 days	<ul style="list-style-type: none"> -Introduction into biogas technology and digester -Example of difference type of biogas plants -Introduction of the main components of biogas plant -Approval conditions for biogas plants under South-east Asia -More topic please see the reference 	Interactive classroom teaching	900 US\$/person	https://goo.gl/evXX7x
International Biogas Operating and Engineering Course	5 days	<ul style="list-style-type: none"> -Current situation and prospects in Germany and Europe -Choosing the right substrates -Pretreatment and prestorage technology -Start up phase and practical measures -How to digest high fibrous and N-rich feedstocks -Process requirements for the monodigestion of chicken manure -More topic please see the reference 	Interactive classroom teaching	1,390 Euro/person (plus 19% VAT)	https://goo.gl/xVyGVr
UK biogas and anaerobic digestion training course	4 days	<ul style="list-style-type: none"> -Practical Digester Biology – Optimization of Biogas Production -Practical Digester Biology – Biogas Plant Safety -Optimization in Gas and Digestate Utilization -More topic please see the reference 	Interactive classroom teaching	1,590 Euro/person (plus 19% VAT)	https://goo.gl/faLYvz
Agro-Urban Biogas Training Seminar and Study Tour	3 days	<ul style="list-style-type: none"> -General introduction into biogas technology for agricultural and urban waste treatment -Basic engineering parameters for the planning of a biogas plant with agricultural and urban substrates -Introduction of the main components of a biogas plant -More topic please see the reference 	Interactive classroom teaching	690 Euro/person	https://goo.gl/LgXqul