Biogas Pilot Project of Animal Faeces in Meunasah Papeun: A Projection towards Renewable Energy Development in Aceh

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ABSTRACT

Aceh has a large potential of biogas energy development. According to Central Bureau of Statistic's data 2012, the total population of cattle in Aceh Province is 701,284. Since 2012, Yayasan Kemaslahatan Ummat – YKU (Kemaslahatan Ummat Foundation) has been developing a biogas energy program made from cow faeces in several subdistricts in Aceh Besar District. The first pilot project was conducted in Meunasah Papeun Village, Krueng Barona Jaya Subdistrict, Aceh Besar District. YKU has been designing reactors which are simple, easy, and affordable, thus they could be developed later on by the community. The biogas reactor is constructed from polyethylene (PE) plastic 0.5 mm, hence the unit price of a biogas reactor would not exceed IDR 10,000,000.- (or equal to EUR 646.25). The process of animal waste out of 100.000 cows would potentially yield biogas energy as much as 36.000 m^3, or when biogas produced is going to be utilized for energy resources, it would be equal to 27 million litres of kerosene per year. If emission of CO_2 is defined as the volume of energy used multiplied by CO_2 emission factor (2.5359), then CO_2 emission out of kerosene consumption is approximately 68.469.300 kg CO_2 per year. On the other hand, about 187,6 ton of CO_2 emission could be reduced per year. From economical perspective, the saving of kerosene at amount of 2,250 kilo litres is equal to IDR 22.5 billion (EUR 1,454,065.48) per month or IDR 270 billion (EUR 17,448,785.70) per year. From 2013 to 2014, YKU is being an implementing partner of USAID for Indonesia Clean Energy Development (ICED) Program, during which 20 household scale biogas reactors in Aceh Besar District are targeted to be developed with carbon emission target to be reduced as much as 281,000 kg CO_2 per year. YKU is also developing biogas energy utilization program in all municipalities/districts in Aceh Province by involving all related stakeholders, those are local governments as well as private sectors through the scheme of CSR (Corporate Social Responsibility), and also includes other third parties through the approach of community development and technical assistances for young generations in the villages to become biogas pioneers in each subdistrict in the whole Province of Aceh.

Keywords: Biogas, Cow Faeces, Renewable Energy, Aceh.

INTRODUCTION

Background

The program of small-to-medium scale biogas energy development in Indonesia began in the early 1970s. The development aimed to utilize waste from biomass in order to find alternative energy sources outside firewood and kerosene. The program was less developed as the people were still able to purchase kerosene and gas that were still subsidized by the government. In addition, other energy sources, such as firewood was still widely available, especially in the villages and the suburbs.

Household biogas development began to gain attention, both from government and the public after the issuance of the Government's policy of reducing subsidies in gasoline since October 2005. Nowadays, the development of household biogas has been increasingly important as kerosene becomes scarce and expensive (more than IDR 10,000 or EUR 0.65 per litre), LPG is expensive (IDR 80,000 or EUR 5.17 per 12 kg), and fertilizer is also expensive. However, the current energy use patterns can not be detached from the consumption of fossil energy as there is not much energy option in Indonesia. This triggers environmental degradation (agriculture, forests, atmosphere), while the scarcity of fertilizer reduces soil fertility. Therefore, biogas energy development by **Yayasan Kemaslahatan Ummat** (**YKU**) or **Kemaslahatan Ummat Foundation** is one of the solutions in order to find alternative energy sources as well as conservation efforts.

Key Issues and Biogas Development Potential in Aceh

Based on the data of "Aceh in Figures 2011", the total of cattle population in Aceh Province is 701,284. Assuming that the empirical data of average faeces generation was 10 kg/day/cow, the cows will generate faeces more than 7 billion kg or 7,000,000 tons of waste per day. Therefore, a cow has the potential to generate at least 0.36 m^3 of biogas, equivalent to 0.75 litre of kerosene. If it is considered that only one-seventh of the cow faeces production in Aceh processed through biogas fermentation, then out of 100,000 cattle will potentially generate 36.000 m^3 of biogas, or if the biogas generated is used as energy source, it can be compared to approximately 75,000 litres of kerosene per day, or 2,250,000 litres per month or 27 million litres per year. If emission of CO_2 is defined as the volume of energy used multiplied by CO_2 emission factor (2.5359), then CO_2 emission out of kerosene consumption is approximately 68,469,300 kg CO_2 per year. On the other hand, about 187.6 ton of CO_2 emission could be reduced per year.

Associated Social and Economic Challenges

With the background and key issues mentioned above, it is illustrated that the utilization of biogas energy has the high potential of social and economic empowerment, as far as there is a party that is willing to initiate and develop this potential to have an added value for the people. Let us go back to the simple calculation above. Assuming that the price of kerosene is around IDR 10,000 per litre, by the utilization of biogas energy, Aceh Province potentially will save energy use of kerosene at IDR 2,250,000 x 10,000 = 22.5 billion rupiah or EUR 1,454,065.48 per month. Based on these calculations, the potential availability of energy source using cow waste is quite large, that is IDR 750 million (EUR 48,468.85) per day or IDR 22,5 billion (EUR 1,454,065.48) per month or IDR 270 billion (EUR 17,448,785.70) per year. A fantastic figure!

In this paper, YKU presents a program that combines the activities of the technical application and community development within a period of one year. It is expected that the activities could be delivering real results of biogas utilization from animal waste, as well as answering the social challenges to make these activities sustainable and can be implemented independently by the society in the future.

Objectives

The program objectives are to increase people's energy independence while at the same time to preserve the environment and to support the improvement of the local economy through the development of household biogas in a sustainable manner. Indicators of change that will be seen:

- At least 20 units of biogas reactor are installed with a capacity of at least 4 m^3 each and well maintained by the society.
- Increased capacity of communities in the development of biogas energy as well as organic fertilizer (bio-slurry) for improvement of agriculture and livestock.
- The utilization of electrical energy and biogas are sustainably operated and managed.

The program that has been carried out since 2012 is being continued with ICED Program (Indonesia Clean Energy Development Program). Indicators of achievement of ICED program are:

- Almost 300 tons of CO_2 emissions reduced out of 23 units of biogas reactor installed.
- At least 600 Watt x 20 reactors = 12 kW of clean energy power generator installed.
- 2,400 m^3 biogas or equal to 1,500 litres of kerosene per month produced.
- 40 households benefited new renewable energy resources out of 3 villages in 3 subdistricts in District of Aceh Besar.
- Two tofu factories will eliminate the use of 144 m^3 of firewood per year with 2,920 m^3 biogas.
- At least 3,000 people in 3 villages are well informed about the program as well as 30,000 people out of 500,000 of Banda Aceh – Aceh Besar population through mass media publication.

Beneficiaries

The program would have direct and indirect beneficiaries. The direct beneficiaries are:

- 20 farmers plus 20 connected households (HH).
- Total of around 250 people (with the assumption 4 to 5 family members per HH).
- Two tofu factories.
- One boarding school.
- At least 10 beneficiary groups will be involved and/or established.
- Six working groups consists of 3 people each will be established, with the total of 18 people will be trained managerially and technically.

While indirect beneficiaries are:

- Stakeholders of Aceh Besar Government, i.e. around 50 government officials from district and subdistrict offices will be advocated and well aware about the program
- Around 3,000 people from 3 villages will be informed through socialization.

The following is area map of YKU Biogas Program in Aceh Besar.

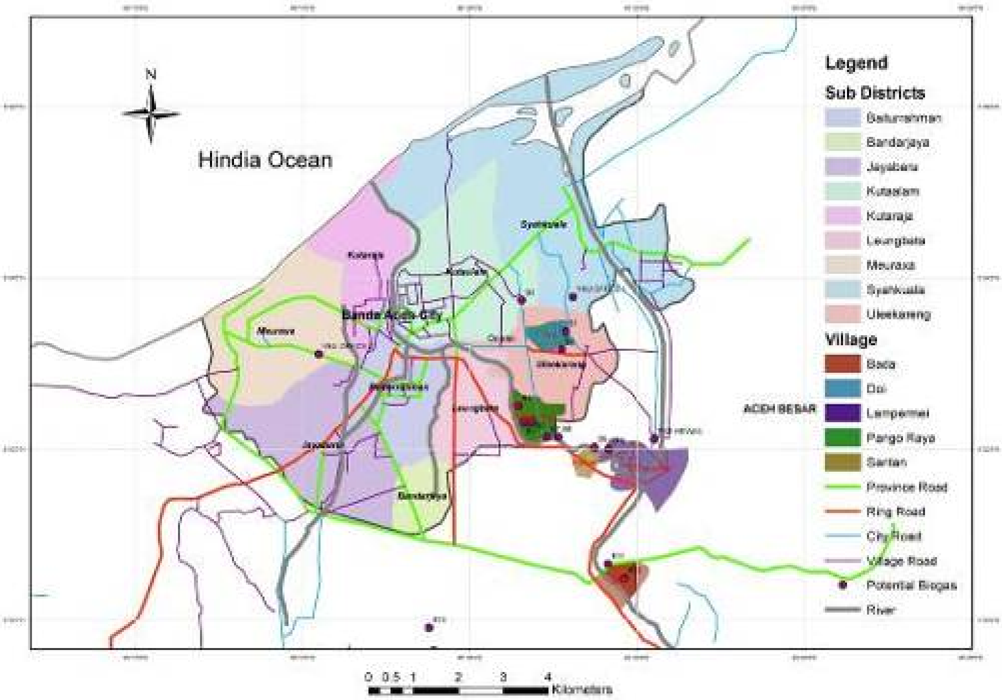

Figure 1. Map of Beneficiaries in YKU Biogas Program

METHODOLOGY

In the attempt to answer the challenge of utilizing alternative energy, YKU is applying a simple biogas technology of organic waste, both animal faeces, waste of tofu factory, and human waste.

Strategy

In this case, the strategy used by YKU to carry out these activities comprised of three strategic approaches:

1. Application of simple technology that is easily maintained by the community.
2. Manufacturing biogas reactor prototype through a pilot-project.
3. Community development, i.e. to involve the community by providing technical training, the implementation of biogas reactor installation, up to maintenance processes.

2.1 Simple Technology

YKU applies a simple reactor biogas technology to process the organic waste.

Material

Plastic biogas reactor consists of 4 (four) chambers:

1. Inlet chamber for raw materials intake.
2. Processing chamber or digester.
3. Outlet chamber for collecting the slurry.
4. Gas reservoir

Inlet and outlet chambers are made of masonry, while the digester and the reservoir are made of poly-ethylene material (PE) or fibreglass. See Figure 2 below.

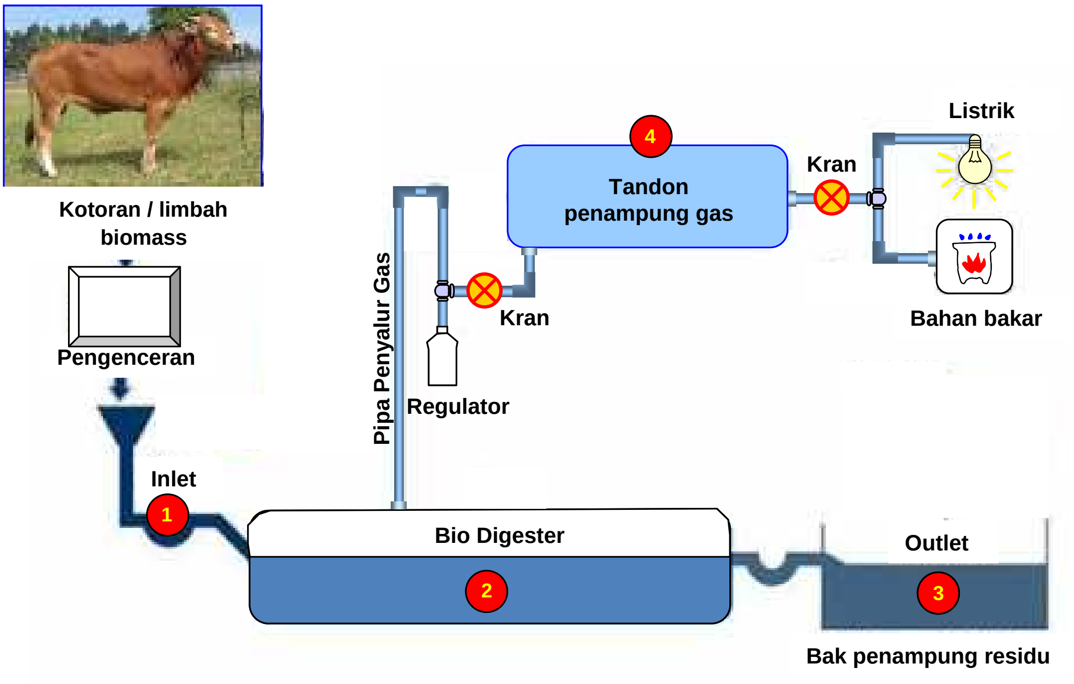

Figure 2. General Biogas scheme of Cow Faeces (Source: YKU)

Apart of those four chambers, there is also a regulator that serves to regulate the gas pressure. If the gas is not consumed, the gas pressure in the reservoir tank and digester gas would be high. In the long run, this pressure will damage the plastic. To reduce gas pressure, then the regulator is used.

Regulators can be made simply of a used plastic bottle. The bottle is connected with T-shape pipe connector. This T would connect, one end to the digester and another one to the reservoir, while the third line is inserted into a bottle with holes in the top and filled with water.

Design

YKU has modified a reactor design which is very simple and economical (more affordable by farmers), as shown in Figure 3 below. It should be noted that the reservoir (chamber 4) is not reflected in this figure.

Installation

The installation of the biogas reactor unit can be briefly described as follows (Source: Environmental Service Program (ESP), December 2008):

1. Cut PE sheet with a size of 5 m (for reservoir) and 7 m (for digester). PE-Plastic that is available in the market is usually a double plastic sheet. See Figure 4.
2. Heat or press both ends and edges of the plastic using plastic heater. If the heater is not available, candle could be used, but it should be more careful not to over- heat the PE as it will leak. Leave a hole about 30 cm in diameter in the middle part for inlet pipe and one more hole for outlet pipe. See Figure 5.

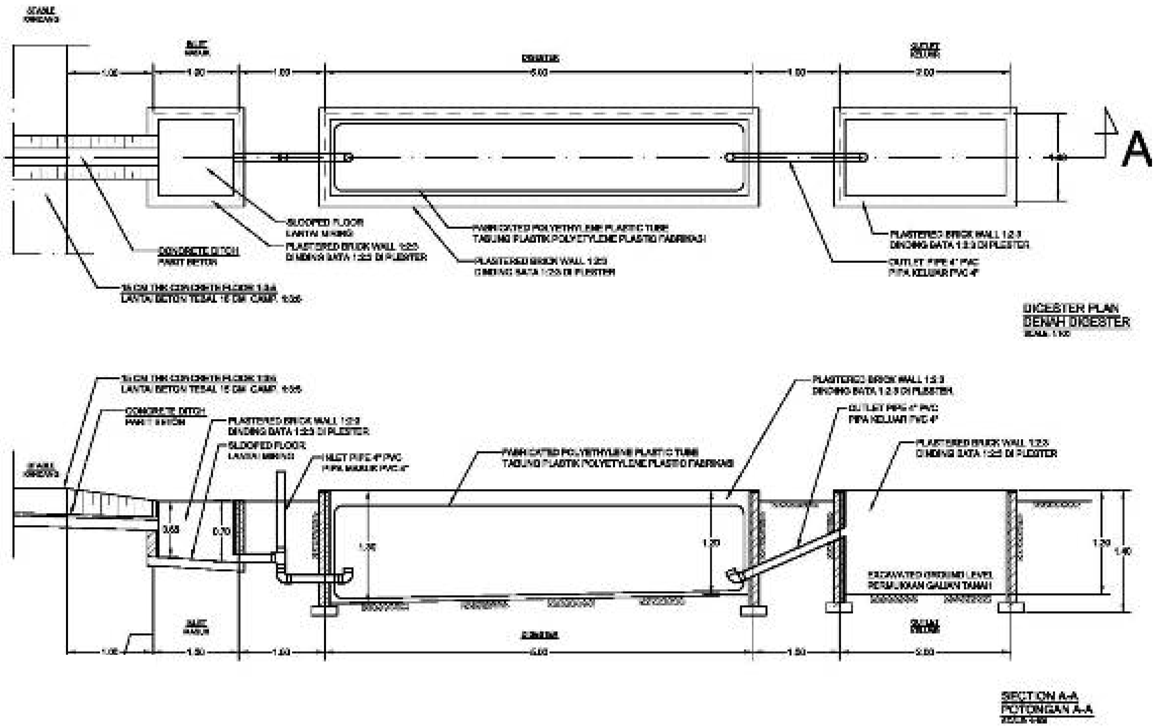

Figure 3. Simple biogas reactor design for cow faeces, modified by YKU.

Fig. 4. PE plastic cutting

Fig. 5. Heating the edges of plastic

When completed, spread both plastic sheets on a large ground.

3. Tie both holes for inlet and outlet with rope. Blow the plastic using a blower or a bicycle pump that inflates plastic perfectly (Figure 6). To test for leaks along the plastic connection and inlet/outlet holes, make a mixture of detergent and water, then slowly pour over the plastic. Note if air bubbles appears, then reheat on the part that is still leaking. Next step, cut 4-inch PVC pipe for inlet/outlet, connect with the elbow and T as per design. Put the pipe into the inlet and outlet holes that have been made, tie the pipe with plastic using tie made of rubber. To protect rubber for its durability, seal the connection with rubber tape (Figure 7).
4. Dig a hole on the ground with appropriate size design, which is about 5 x 1 m and 1.3 m depth (Figure 8 and 9). Considering that Aceh is earthquake prone area, it is advised to make the construction of brick walls with the composition of cement-gravel-sand 1: 2: 3 and plastered, to protect the plastic. Once cement plaster dried, put digester plastic into digester pit. Make sure that the plastic is not bent, twisted, folded, or pierced by something (e.g. sticks, equipment, etc.) thus the plastic does not leak.

Fig. 6. Leak test for digester. Fig. 7. Tie inlet pipe with rubber tape.

5. Put the rubber ring that is flanked by a PVC ring at the methane release hole. Connect with threaded shock inside and outside. Use PVC glue to reinforce this connection. Connect the PVC end with 0.25 inch PVC pipe. Use clamps to lock the connection, thus it would not move.
6. Using a blower or pump, fill the plastic with air to inflate digester perfectly. Once filled with air, close with PVC cap, hence the air does not flow out.

Fig. 8. Digester pit of plastered brick Fig. 9. Installation of plastic digester

7. Fill inlet and outlet PVC pipe with water in order to prevent the air does not come out.
8. Digester is ready to be filled with cow dung.

2.2 Experimenting through a Pilot Project

A. Pilot Project Approach

The process of biogas reactor technology development has been performed in 2012 through several stages, namely:

1. Researching on biogas reactor design.
2. Engineering and modifying the design with the main material of plastics, adapted to local conditions and community affordable prices.
3. Testing and commissioning in the field.

A pilot project has been conducted by YKU in Meunasah Papeun Village, Krueng Barona Jaya Subdistrict, Aceh Besar. Factor of technology is actually not a big obstacle as described above. The technology used is relatively simple and affordable by the villagers. A more important factor is post-installation stage, i.e. the willingness of the people to operate the reactor on their own and to perform maintenance and repairs when damage occurs.

For such purpose, YKU conducted socialization activities in Meunasah Papeun Village concerning biogas energy out of cattle manure. The identification was targeted to several farmers to find those who are interested in this biogas reactor. YKU performed a simple qualification to select one farmer who fit with the following requirements:

1. Has a minimum of 3 cows.
2. Self-owned cattle, with experience more than 5 years.
3. Has cows that are kept in a cage.
4. Cage at least semi-permanent one.
5. Able to provide regular feeding for the cattles.
6. Sufficient water resource to clean the cage.
7. Interested in biogas technology.
8. Willing to get assistance from YKU.
9. Willing to contribute labour, labour wage, and some materials.
10. Willing to operate and maintain the biogas reactor.

YKU developed a simple questionnaire to test parameters of the above requirement, which are the subject for evaluation before determining those who is really ready to implement a pilot project with YKU. The questionnaire was disseminated door-to-door to some farmers, while at the same time observing the condition of cattle owned by farmers. After the selection of one farmer, the installation process and reactor construction started.

B. Engineering of Biogas Installation

Inlet

Engineering at the inlet does not require special skills, because the function of the inlet is just to accumulate, stirring, and dilute the dung. In this case, the inlet is made of red brick and cemented with varying dimensions. See Figure 10.

Fig 10. Inlet, cemented bricks

Fig 11 Reservoir with capacity 4000 l.

Digester and Biogas Reservoir

Digester is made with simple technique, i.e. made of PE-plastic materials (or fibreglass) with the capacity of 4000 litres. Another chamber is the reservoir for methane storage (Figure 11).

Outlet

Constructing the outlet is the same as the inlet, not requiring special skills, as the function of the outlet is to collect residual waste after processing in the digester. Outlet is made of red brick and cemented with a volume of about 2m·

2.3 Community Development

Community development is the key to the sustainability of this program. Installation of reactor unit is not a difficult task, however, to ensure that the reactor unit can be operated and maintained by a community properly, it requires outreach efforts, undertaken since the beginning of the activity.

In short, the community development performed by YKU is activities described below.

A. Early socialization and community selection process.
B. Trainings for facilitators, beneficiaries, and comparative studies.
C. Implementation of the biogas reactor construction by the community.
D. Socialization about biogas utilization.
E. Establishment of Beneficiary Groups for livelihood improvements.

The approach for community development and information dissemination of biogas development activities that is carried out through:

1. Coordination with the government, related agencies and district officials through *silaturrahim* (good relationship) and official events, expecting that the access to the program information would be able to be addressed to 20 officials, municipalities and related agencies, includes 30 subdistrict officials in Banda Aceh and Aceh Besar, with information access projected to reach 150 males and 50 females.
2. Launching of program that would be followed by approximately 40 households of target beneficiaries of cattle farmers, tofu factory owners, and boarding school principals, with a projection of 240 people, consisting of 180 males and 60 females.
3. Distributing brochures at 1000 pages during each event, such as launching, village meetings and socialization, technical training, etc. so that the information about the program and the construction of biogas spread out in Banda Aceh and Aceh Besar and accessed by 750 people.
4. Campaign of biogas development through Kutaraja TV with the target audience of more than 30,000 viewers in Banda Aceh and Aceh Besar.
5. Technical training will be followed by 15 males and 5 females.
6. ToT for improved capacity in biogas field with number of participants of 8 males and 2 females.
7. Biogas energy development involves approximately 25 males and 20 females in beneficiary groups.
8. Socialization of biogas utilization to:
    a. Village community: 100 male and 300 female through religious community meetings.
    b. College students comprise of 200 female and 200 female students.
9. Facilitation to 10 beneficiaries groups and 10 compost groups, each group consists of at least 3 females.
10. Inauguration of biogas development program, which would be attended by 100 males and 50 females.

RESULTS AND DISCUSSIONS

The development of biogas from animal faeces would have a number of benefits, both indirect and directly benefits.

Indirect Impact

Since the main products of this renewable energy development are biogas and organic fertilizer, the program would indirectly have positive impacts to the environment:

- contributes to forest, soil, and water conservation,
- reduces pollution,
- improves environmental sanitation,
- supports government policies in reducing fuel subsidies, also
- indirectly supports international programs that reduce the negative impact of the greenhouse gas effect.

The utilization of biogas in reducing the greenhouse effect occurs in three ways. The first, biogas is a substitution of fossil fuels for cooking and lighting. Second, the installation of biogas from animal faeces generates fermentation process that converts methane into CO_2, thereby reducing the amount of methane released into the atmosphere. The third, the application of biogas technology would have an impact on forest conservation, as logging activity can be reduced. With forest conservation, then CO_2 in the air will be absorbed by forests and processed through photosynthesis produces oxygen, which is against the greenhouse effect.

Furthermore, this effort can be proposed as part of the program of Clean Development Mechanism. Indeed, methane gas along with carbon dioxide (CO_2) included in the greenhouse gas, giving "greenhouse effect" that cause global warming phenomenon. By developing a biogas development program, the methane gas from cow manure produced will be converted and utilized as a source of energy, thereby reducing the production of methane gas released into the atmosphere and can play a positive role in solving the global problem of greenhouse effect.

Direct Impact

The impact directly felt by farmers is an alternative energy source in terms of:

- biogas would be used as fuel for cooking.
- power source of generator for electricity for lighting and other household necessities, such as water pumps, television, fans, and others.
- In addition, other direct impacts which can be benefited directly from the development of biogas is a ready-made supply of organic fertilizer.

If we calculate those direct impacts mathematically, it would possible not give a promising figures. However, YKU has three targets in order to make this program has a wider impact:

1. Semi-communal Reactor.
   A biogas reactor is targeted to be used not only by a family, but at least two families. For this purpose, YKU would establish beneficiary groups and conduct training, facilitating community groups, and mentoring includes capacity building in terms of technical management, operation, and maintenance.
2. Campaign and Socialization.
   The main target is to gradually change the mindset and energy use patterns of conventional energy consumption towards alternative energy consumption. Mentoring and facilitation processes would be performed by YKU, beyond the implementation of the ICED program.
3. Independent Community
   The implementation of the program would done with the selection process to recruit farmers and beneficiaries who have an interest and willingness to partner with YKU during the program and beyond. The target is to encourage the community independence in term of energy consumption. This would be performed by YKU through encouraging the people to contribute during construction of biogas reactor units in order to grow the sense of belongingness the biogas reactor. Thus, gradually the attitude of independence would be formed and slowly YKU would be releasing the facilitation to optimize the sustainability of the program

Carbon Emission

According to Pusat Penelitian dan Pengembangan (Puslitbang) Permukiman, Ditjen Cipta Karya, Kementrian PU (Ministry of Public Works), the amount of CO_2 emissions out of human activity is calculated by a formula as follows:

$$ECO_2 = A \times FE$$

E_{CO2} = CO_2 emission

A = activity data (kWh of electricity, litres of kerosene, etc.)

FE = emission factor (kg CO_2/kWh, CO_2/litre kg kerosene, etc.)

The emission factors of some emission sources according to the empirical data are as follows:

- Gas Tube : 3 kg CO_2 / kg of gas
- Kerosene : 2.5359 kg CO_2 / litre
- Electricity : 0.719 kg CO_2/kWh

In addition, still according to Puslitbang Permukiman, based on empirical data, for the average household electricity use of 125 kWh (a family with an average income of IDR 500.000, - to IDR1,000,000, - per month), the estimate of CO_2 emissions are 90 kg CO_2 / month.

The amount of carbon emission reduced in one year during the implementation of ICED Program could be calculated as follows:

1. Biogas reactor 20 units would be utilized by 40 HHs, thus the total number of beneficiaries is 40 families. If it is assumed that the consumption of kerosene per HH is 2.5 litres / day, the total consumption of kerosene for 40 HHs is 100 litres per day, or 3,000 litres per month, or 36,000 litres per year.

   If 40 HHs are no longer buying kerosene, and as substitutes using biogas energy, then the value of E_{CO2} that can be reduced with the use of biogas is:

   - 36.000 x 2,5359 = 91.292,4 kg CO_2 per year.

2. Assuming the use of gas tube is 1 tube per HH per month (for 1 HH = 4 family members), or 12 kg / HH / month. Thus, for 40 families, the use of gas tube is 480 kg per month, or 5,760 kg per year.

   Similar with the use of kerosene, if 40 HHs will no longer purchase gas tube 12 kg, and as substitutes using biogas energy, then the value of ECO_2 or carbon emissions that can be reduced with the use of biogas is

   - 5.760 X 3 = 17.280 kg CO_2 per year

3. It would be too optimistic if biogas energy is targeted to replace the electricity consumption of households totally in a day at 125 kWh. Nonetheless, YKU noted that the use of biogas-powered electricity generators which were conducted during the pilot project was able to turn on the generator for 3 hours or 1/8 of a total of 24 hours. If the coefficient rate of 1/8 is used as the basic assumptions and multiplied with electricity usage of 125 kWh in a day, then the figure is around 15 kWh per HH per day as the maximum capacity of biogas for electricity consumption. Thus, 15 kWh per day x 40 HHs = 600 kWH per day, or 18,000 kWh per month, or 216,000 kWh per year.

   Under the usege of electricity for 3 hours per day for the 40 HHs of biogas energy, then the value of the ECO_2 that can be reduced is

   - 216.000 x 0,719 = 155.304 kg CO_2 per year.

4. A tofu factory spent 3 m^3 of firewood per week at a price of about Rp 400,000,- or Rp. 1.600.000,- per month. The price is equivalent to 20 kg of gas tube 12 kg, or 240 kg of gas consumption per month, or 2,880 kg per year. For two tofu factories that would use biogas energy, the gas consumption would be 5,760 kg per year.

   Then the value of ECO2 carbon emissions that can be reduced with the use of biogas is

   - 5.760 X 3 = 17.280 kg CO_2 per year.

Once again, those figures of carbon emission reduced are still relatively small. However, YKU as a local NGO would continue this program after ICED Program is completed and performs more extensive development, both in Banda Aceh and Aceh Besar, as well as in other areas in Aceh and throughout Indonesia, in partnership with other third parties.

In general, out of biogas reactor of 20 units and 40 HHss targeted beneficiaries, and 2 tofu factories, the output from this program is as follows:

Table 1. Carbon Emission Reduced out of YKU Biogas Program

No.	Source of Emission (Equivalent)	Energy Consumption	Carbon Emission Reduced (kg CO_2/year)
01.	Kerosene	36.000 l / year	91.292,4
02.	Gas tube	5.760 kg / year	17.280,0
03.	Electricity	216.000 kWH / year	155.304,0
04.	Gas tube for 2 tofu factories	5.760 kg / year	17.280,0
		TOTAL	281.156,4

Remarks:

Calculation for boarding school is excluded, as it is not considered as production activity.

Sustainability

Sustainability factors of biogas reactor technology package that is the advantage of the program for the long term (5-25 years) are:

a. Resources Availability

Availability of conventional energy sources currently scarce and expensive, such as kerosene is difficult to find and expensive at IDR 10,000,- / litre. In addition, fertilizer distribution problems that make it difficult to purchase fertilizer in the market and the issue of global warming and environmental degradation, a triggering factor of the development of biogas installations.

b. Simple Design

Biogas reactor design is made of simple plastic or fibreglass, meaning that it can be replicated by the community. By looking at the potential of the existing farms in Aceh, the household biogas production capacity could be increased following public demand and support from third parties.

c. Practicality

This biogas installation is such that they are ready to be installed. Installation could be adjusted to the location. If the location is sloped, it is ready to be installed, but if the location is flat, then the ground should be excavated to put the biogas reactor. This installation requires only 2 workers with short installation time is 1-2 days per unit.

d. Affordable Prices

The unit price is around IDR 10.000.000, - (ten million rupiah) per unit, including installation costs, but not including the cost of facilitation and capacity building. One unit consists of inlet, digester, outlet, and the reservoir, includes pipes 4-inches 2 m, 6-inch 2 m, and 0.5-inch 5 peaces (20 m).

e. Replicability

YKU intends to replicate this activity, both in the area of Banda Aceh - Aceh Besar, as well as in other areas in Aceh and in Indonesia. YKU has received supports from the governments, in this case the Municipality of Banda Aceh and Aceh Besar District government. Among the supports are:

1. The support of the Municipality of Banda Aceh who actively participates in providing support and presents in YKU's biogas development activities.
2. Support of the Government of Aceh Besar District, c.q. Department of Mines and Energy.
3. Support from Camat Krueng Barona Jaya to develop biogas energy in Krueng Barona Jaya Subdistrict, as it is known that the District Krueng Barona Jaya is one of the cattle source in Aceh Besar by the number of cattle reach approximately 5000 cows (BPS, 2011).

CONCLUDING REMARKS

With short-term development plan (through ICED-USAID program), as well as long-term strategic plan, as described above, YKU expects the positive impact of these activities can really be addressed to the people in Aceh:

- Contribution of CO_2 emission reduction of almost 300 tons at the end of this project in 2014, contributes to emission reduction efforts, and is expected to continue to reduce further in the following years with the widespread use of biogas energy specifically in Aceh, and throughout Indonesia in general.
- Improving and expanding community energy independence, thus the people does not depend on fossil energy and electrical energy supplied by the Government.

Beneficiaries obtain significant economic benefits as an added value, i.e. the transfer of conventional energy consumption costs to other productive expenditure for additional family incomes, cost of education, health, and other costs of living.

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