"Project Formulation Survey" under the Governmental Commission on the Projects for ODA Overseas Economic Cooperation in FY2013
Summary Report

Republic of Indonesia

Electrification Promotion by Small Scale Biomass Power Generation System in Non-electrified Regions

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Pro-Materials Co., Ltd.
RENOVA, Inc.
Joint Venture

The content of this report is a summary of the project formulation survey, which was commissioned by the Ministry of Foreign Affairs of Japan in the FY 2013 and is carried out by the consortium (Pro-Materials Co.,Ltd and RENOVA, Inc..). It does not represent the official view of the Ministry of Foreign Affairs.

Introduction

The Republic of Indonesia has maintained a 5% annual growth and is expected to increase its demand for electricity in future. Indonesia's electrification rate differs by region and the national electrification rate remains 66.7% (2010). Island areas other than Java have low electrification rates and there are areas of which electrification rate is lower than 30%

In East Nusa Tenggara Province, which is the main target area of this survey, the electrification rate is as low as 28% and about 70% of residents live without electricity. In Sikka Regency of East Nusa Tenggara Province, one of the surveyed regions, agriculture, forestry and fisheries are the main industries and the ratio of primary industries (agriculture, forestry and fisheries) in the total production is 44.8% (2009). Meanwhile, manufacturing industries are extremely underdeveloped and the relevant ratio of manufacturing industries is only 1.6%, failing to turn out added value of primary products. Lack of electricity resource development is one of major setbacks for progress in manufacturing industries. Also, it falls behind remarkably in the fields of medical care / hygiene and education. The province's average annual per capita income remains about 200 US dollars and its poverty rate is 23.3%, making the province one of the worst four in Indonesia. Therefore, for future development of this area, it is necessary to foster new industries and supply electricity for those industries. Electrification needs for the BOP (the Bottom of the Pyramid) group is especially high.

PLN, the national electric power company, is in charge of electric power supply development, however, they have tendencies to put aside island areas as it requires huge costs to prepare the grid for supplying power to island areas. As a solution to this situation, this survey aims at realizing independent electric power supply in cooperation with local NGOs, local governments, companies, etc.

Ⅰ. Description of the current situation and development needs of the concerned development issues in the surveyed country

The Republic of Indonesia has been achieving rapid economic development with its real economic growth rate in the high range of 5.5% to 7.0% since the year 2005. However, with its increase in energy consumption, it turned into a net energy importer in spite of abundant domestic energy resources, and it is urgently necessary to take actions to address energy issues such as a shift from electricity generation by petroleum and light oils into coals, introduction of renewable energy, promotion of energy saving and so on.

Meanwhile, in island areas and rural regions far from cities, there is no good prospect of the grid preparation by PLN, making many residents dependent on limited power generation by diesel or gas generators. East Nusa Tenggara Province, the target area of this survey, has the second lowest electrification rate among the total 33 provinces in the Republic of Indonesia.

In recent years, capital investment by PLN in power generation facilities and the grid has been advancing, and in the east Flores region where Sikka Regency belongs the electrification rate of the year 2011 has increased by 169% to 63.7% from 37.7% of the year before. However, the ratio of electrified villages in 2011 is 54.7% for the east Flores region and 46.5% for the whole province, leaving more than half of all the villages non-electrified yet.

In these areas, power generation systems by which residents can operate and maintain on their

own without relying on fossil fuels with its prices soaring , are required.

Table: Electrification Status in East Nusa Tenggara Province

Item	Region		2007	2008	2009	2010	2011
Electrification rate (%)	Branch	Kupang	25.2	25.9	25.9	28.1	41.6
		West Flores	19.9	21.1	21.8	23.6	39.9
		Sumba	12.8	13.1	13.2	15.4	23.3
		East Flores	29.9	32.2	34.9	37.7	63.7
	Province total			23.7	24.1	26.4	41.6
Ratio of electrified villages (to all the villages) (%)	Branch	Kupang	41.3	41.7	43.2	46.0	49.5
		West Flores	46.6	47.2	48.6	50.1	53.4
		Sumba	31.0	31.7	33.7	37.4	38.2
		East Flores	44.5	44.6	46.0	48.2	54.7
	Province total			42.1	42.6	44.1	46.5

（Source：Data provided by PLN East Flores Branch）

Ⅱ. Possible applicability of the SME's products and technologies, and prospects for future business development

The Stirling engine power generation system which is an external combustion engine system and the product of Pro-Material Co., Ltd., converts the heat of direct combustion of biomass into electricity by expansion and contraction actions of the air inside. Its characteristics are as follows,

① Various kinds of biomass resources in each region can be used as fuels.
② It has good portability and is easy to install. It is packaged by 5kW, and only piping and electric construction is necessary for installation, which enables lowering of construction costs.
③ Maintenance operation is easy.
④ It contributes to CO2 reduction as biomass power generation.
⑤ The output is customizable from 5kW to 100kW. Depending on available biomass resources in the installation site, the system output can be customized by simply increasing or decreasing the number of the engine system.

The primary business scheme is that Pro-Material Co., Ltd. sells biomass power generation systems to factories, IPPs, etc. in cooperation with local companies. For the time being, Pro-Material Co., Ltd calls for local cooperating companies by introducing the technology, and cooperates with those local companies in sales and maintenance activities. Organizing a local joint venture is considered to be one possible option.

In case biomass power generation systems are to be sold to factories, the systems can be installed as private power generators in places such as rice mills, etc., where a large amount of biomass resources are discharged. Also, in consideration of the scale of power generation as small as a few kW, utilization as small-scale distributed type power generation is considered to make the most of characteristics of this technology. Hence, in this survey, feasibility of introducing this technology was examined, assuming that it is introduced especially to non-electrified areas.

The possible schemes for power generation projects in non-electrified areas are as follows,

① Scheme of selling electricity through FIT so that PLN is in charge of fee collection and the grid preparation
② Government of the Republic of Indonesia provides subsidies for equipment installation and the grid preparation, and local residents cover maintenance costs by self-governing associations.

Field surveys at villages where electrification has been realized by independent distributed type power generation such as diesel or solar power revealed examples of independent distributed type power generation operated by a local self-governing association in villages. These examples show that it is feasible that a power generation project is operated mainly by a self-governing association in a village. The issue for consideration, however, is how to fund initial investment. Support from the government of the Republic of Indonesia, utilization of Japan's ODA, Joint Crediting Mechanism (JCM), etc. should be taken into consideration for initial investment funding.

Ⅲ. Verification of adaptability of the SME's products and technologies to the surveyed country (Demonstration and pilot survey)

A unit of small-scale biomass power generation system, the surveyed technology, was installed in Maumere, East Nusa Tenggara Province for demonstration in order to test combustion with local biomass fuels and to introduce the system to local residents.

Staff members from Ministry of Energy and Mineral Resources and from PLN East Nusa Tenggara Province Branch, local residents of non-electrified villages, etc. attended the workshops where active discussions were held regarding types of biomass fuel resources, specific maintenance methods, challenges for introduction in non-electrified villages, etc. In consideration of the results of the field surveys and workshops, the following four suggestions were raised so that a Stirling engine is to be locally accepted and distributed

Specific suggestions for optimization

(1)Operating gas pressure needs to be around from 0.5MPa to 1.0MPa to be appropriate for local production.
(2)Air that is easy to be produced in Indonesia needs to be selected as operating gas
(3)A heat exchanger needs to be designed so that both maintainability and functionality meet the requirements.
(4)A cooling system that requires low costs both for installation and for operation needs to be adopted.

Ⅳ. Expected development impact and effect on business development of the proposing SME(s) in the surveyed country(ies) through proposed ODA projects"

Development issues in non-electrified areas of the Republic of Indonesia are summed up into three; ①Scarcity of power resources to support industries, ②Sustainable power resources for local residents economically and technically, and ③Environmentally friendly power resources. Expected development impact and effect of this technology on those issues are as follows,

① Development effect on procurement of power resources that support industries
This power generation system uses biomass resources as fuels with output electricity of a few to 100kW and is appropriate for contribution as private power generator at plantations, etc. where the field surveys were conducted in consideration of the amount of available biomass fuels and electricity consumption at the facilities.

② Development effect on procurement of power resources that local residents can manage maintenance
The most important characteristics of this power generation system is that the generator is external combustion type which requires easier maintenance operation than internal combustion type does. It is assumed that maintenance operation of this technology can be managed without problems by technicians who are capable of motorcycle maintenance.

Also, price fluctuation of biomass fuels is smaller than that of petroleum fuels. In recent years, the price of petroleum has been increasing and imposing more financial burdens on local residents. This technology enables steady supply of fuels, as it generates electricity by using local biomass resources as fuels

Thus, this technology provides power resources that can be operated and maintained by local residents in consideration of two aspects of technical compatibility and fuel supply stability.

③ Development effect on procurement of environmentally friendly power resources
This power generation system uses biomass resources as fuels and could become alternative solution to power generation systems such as diesel or gas that uses petroleum as fuels. It can realize reduction of GHG caused by petroleum products. If a unit of diesel power generation system is replaced by a unit of this system for operation of 6 hours per day for 365 days per year with 10 kW output, the effect of GHG reduction is assumed to be 17.5t/year.

Meanwhile, the demonstration period of a whole year would be required in order to determine to what level local residents can accept procedures of operation and maintenance, and to observe seasonal changes of biomass resource availability and power generation capacity. Through ODA project formulation, demonstration of this power generation for at least more than one year needs to be conducted in order to determine improvement points to make the system easily accepted by local residents, select potential biomass fuels from both aspects of collection and combustion performance, form biomass collection framework, and discover local partners for maintenance operation, etc., ensuring and developing the basic structure of project procedures in the Republic of Indonesia by Pro-Materials Co., Ltd.

Ⅴ. Proposals for formulating ODA projects

Utilization of ODA can be considered with two phases.

（1） Phase of technology introduction
According to Ministry of Energy and Mineral Resources and Ministry of Development of Disadvantaged Region, in the Republic of Indonesia, there are almost no successful cases of

small scale biomass power generation similar to this technology. Therefore, in order to distribute this technology, it is necessary to show people in the Republic of Indonesia that this system and the operational scheme are feasible. It would make easier to raise a fund by increasing interest in this technology from the national government, local governments, private companies, micro-finance institutions, etc.

Utilization of the following projects is considered to be possible. Through discussions with associate organizations, utilization of one of the projects will be examined in order to link the selected project to distribution of this technology after the next fiscal year. Which project is to be selected is currently under consideration among concerned parties as the results of this Feasibility Study.

①Pilot survey for disseminating SME's technologies

Projects aiming at proving that products/technologies of Japanese small and medium sized enterprises contribute to development of developing countries as well as enhancing local management and distribution. Supported by Japanese government, Pro-Material Co., Ltd. is to implement demonstration equipment, proving that this technology contributes to development.

②Grant Assistance for Japanese NGO Projects

The Ministry of Foreign Affairs of Japan provide financial support for economic and social development projects in developing countries operated by Japanese NGOs. The possible scheme would be that APEX, a support NGO of this survey, utilize this funding and the technology of Pro-Materials Co., Ltd. as a form of development cooperation in Sikka Regency.

③Grant Assistance for Grass-Roots Human Security Projects

It gives financial support for relatively small local projects carried out by international or local NGOs and etc. The possible scheme would be that Yayasan Dian Desa utilize this technology for their project with this financial support.

（2） Phase of implementation

After introducing the technology through demonstration to the Republic of Indonesia and raising interest from stakeholders, utilizing ODA for initial investment funding is considered as a possible scheme in the phase of technology implementation. At the stage of full implementation, ODA can be utilized for training policy makers and technicians to be in charge of biomass utilization in cooperation with local government agencies and companies, as biomass power generation technologies are not generally being used in Indonesia at the moment.

① Utilization of technical assistance(expert dispatch) and technical training (trainee intake)

Technical assistance and technical training are to be conducted in order to promote biomass utilization including the use of this technology. Expert dispatch to Sikka Regency government and East Nusa Tenggara Province government and technical trainee intake from these governments are to be organized. This should be aimed at promotion of biomass utilization in general, regardless of the use of this technology. Pro-Material Co., Ltd. is considered to be able to be involved in the process as expert resources and as a study tour venue.

Attachment : Outline of the survey

Project Formulation Survey
Republic of Indonesia, Electrification Promotion by Small Scale Biomass Power Generation System in Non-electrified Regions

SMEs and Counterpart Organization

- Name of SME : Pro-Materials Co., Ltd.
- Location of SME : Tokyo, Japan
- Survey Site・Counterpart Organization : Republic of Indonesia・Sikka Regency government in East Nusa Tenggara Province

Concerned Development Issues

- The electrification rate of Republic of Indonesia is less than 70% and in many parts of island areas, less than 30%
- In East Nusa Tenggara Province, the main surveyed area, the electrification rate is so low that manufacturing industries are underdeveloped, failing to turn out added value of primary products.
- Biomass power generation matches the development needs of rural villages and its utilization is expected

Products and Technologies of SMEs

Small-scale biomass power generation system with Stirling engine that uses biomass as fuels

- The output is customizable from 5kW to 100kW.
- Various kinds of biomass resources in each region can be used as fuels.
- Maintenance operation is easy, with simple design.
- It contributes to CO2 reduction as biomass power generation.

Proposed ODA Projects and Expected Impact

- Pilot survey for disseminating SME's technologies
- Grant Assistance for Grass-Roots Human Security Projects
- Technical assistance(specialist dispatch) and technical training (trainee intake)

Impact: electrification of non-electrified regions, creation of industries that utilize biomass power generation, distribution of locally adapted technology

Future Business Development of SMEs

Power generation system introduction in non-electrified areas and into factories etc. where biomass resources are discharged.

- Sell the system to enterprises, utilizing Feed-in tariff (FIT) for renewable energy
- Aim at cooperation with local partners for manufacturing and sales