Konsorsium PETUAH (Perguruan Tinggi Untuk Indonesia Hijau)

Pengetahuan Hijau Berbasis Kebutuhan dan Kearifan Lokal untuk Mendukung Pembangunan Berkelanjutan
(*Green Knowledge with Basis of Local Needs and Wisdom to Support Sustainable Development*)

POLICY BRIEF

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Revitalization of Renewable Energy Generation in Nusa Penida

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BACKGROUND

Tiga Nusa is a group of small islands in the southeast of Bali separated by Badung Straits. The group consists of Nusa Penida, Nusa Ceningan and Nusa Lembongan islands. The electricity network of Tiga Nusa is isolated from Bali. Most of the used electrical energy is produced using fossil-based fuel power plants, although the islands have a high potential of natural energy resources. The identified potential of natural energy in the islands include PV electricity generation, wind power electricity generation, as well as electricity from sea waves and currents. Biofuel production from jatropha has also been identified.

From this perspective, the islands have huge potential for renewable generation. In fact, many of these resources have been captured and used to generate electricity. For example, wind turbines, solar photovoltaic, and biofuels production facilities have been developed. The projects are built by government or state-owned-enterprises and handed over to local communities.

In general, most of the renewable energy pilot projects in Nusa Penida also have experienced problems and many of them are now actually abandoned and require substantial repairs. The central government of the Republic of Indonesia has allocated budget to revitalize these facilities including conducting repairs to many of these plants.

ELECTRICITY GENERATION

A. Diesel Power Plant

The electricity network in Tiga Nusa (Nusa Penida, Nusa Ceningan, and Nusa Lembongan) is mainly supplied by a diesel power plant with an installed capacity of 7.68 MW and with a maximum power of 5.06 MW. The daily peak demand of the system is approximately 4.70 MW, with an energy consumption of about 60 MWh [1].

Policy Recommendations

- Detailed study and analysis on potential resources is required before carrying out an RE project.
- Determination of basic specification and engineering standards for energy conversion technology that are suitable for Indonesian condition.
- Reducing investment cost by production intensification in Indonesia.
- Provide a priority on the RE development in the areas with high potential of resources and sosio-economics.
- Capacity building on the applied technology for the operators and management is required to maintain the continuity of the equipment operation and network reliability.
- Socialization on the applied RE technology is important to promote the environmental protection for a successful implementation of the RE generating system.
- Provide financial insentive for RE development

There is a main substation with a diesel power plant in Kutampi, Nusa Penida and smaller substations in Jungutbatu, Nusa Lembongan. There is also an interconnection feeder that connects the two substations and crosses straits between Nusa Penida and Nusa Ceningan as well as between Nusa Ceningan and Nusa Lembongan.

Figure 1: Tower for electricity network crosses straits between Nusa Penida and Nusa Ceningan

B. Photovoltaic System

In addition to the conventional diesel power plant, RE generating systems are also installed to provide electricity for the islands. This includes solar PV systems with a total capacity of about 62 kWp and wind power generating systems of 720 kW. These two generating systems are expected to deliver a maximum power of about 780 kW. The solar PV and wind power generating systems are both connected to the main substation in Nusa Penida.

As the position of Tiga Nusa is between 8.6 and 8.8 South Latitude, the sun shines all over the year. The position provides advantages in generating electricity from solar energy. The Nusa Penida PV system #1 and Nusa Penida PV system #2 have a capacity of 32.4 kWp and 30 kWp respectively. The plants were developed by PT PLN (Persero) and are connected to the local distribution network through a 20-kV connection.

Figure 2: PV generating system in Nusa Penida

Both plants use the BP 3150N solar module of 150 Wp, manufactured by BP Solar. System #1 uses 216 modules and system #2 uses 198 modules. Each plant uses six units

of SMC 5000A inverters made by SMA Australia each of 5 kW capacity [3]. However, due to technical problems, both plants are no longer in operation.

C. Wind Power

Wind map by LAPAN indicates that Nusa Penida has the potential of wind energy on which the wind speed falls in the range of 3 to 5 m/s [5]. Further, site measurement by Budiastra et al reported that wind speed varies between 3.2 to 8.02 m/s [6].

Nusa Penida island is one of the first pilot projects of the wind turbine in Indonesia. The project was started in 2005 with the construction of an 80-kW wind turbine. The project continued and in 2007, nine turbines were constructed giving a total capacity of 720 kW. The plant is connected to the local grid system, forming a hybrid wind-PV-diesel system [3]. Nevertheless, all the wind power system has also stopped in producing electrical energy due to a technical problem.

Figure 4: Wind power generating system in Nusa Penida

THE REVITALIZATION

Recently, the BPPT has begun to run a revitalization project namely WhyPGen for the hybrid power system in Nusa Penida. The project was started with re-operate an 80kW wind power generating system and a 32kW photovoltaic system. The remaining RE power generation systems will be included in the following project milestones. The program was initiated by BPPT and UNDP Indonesia with financial support from the Global Environment Facility (GEF). The main goal of the project is to increase the wind power contribution in electricity generation hence reducing CO_2 emission from burning fossil fuel.

In addition to the revitalization of the hybrid power plant, the project also covers the installation of a smart control system, that certainly will maximize energy penetration from RE power generation systems. The application of smart control is an embryo of the smart grid system to increase energy efficiency, supply flexibility, self-healing capability from network disturbances, and higher delivered power quality. The installation of the main equipment for the revitalization program includes digital power meter for each unit in the hybrid system, communication network and SCADA system to control output power from each generating system and load sharing controller for power-sharing monitoring and control.

In terms of supply reliability, the application of smart control system provides real-time condition assessment of the network, hence fault occurrence within the network can be immediately isolated. The network recovery then automatically controlled and alternative sources will deliver the electrical power.

OPPORTUNITIES AND CHALLENGES

The opportunities in the application of hybrid power generating system may be seen from the following perspectives:

- An increase in energy needs.
- A relatively low electrification ratio.
- Limited fossil energy reserve.
- Increasing environmental awareness of the community.

The application of hybrid power offers the following advantages:

- Requires no fuel
- Sustainable
- Environmentally friendly
- No sewage-related problems
- Support energy diversification program

In contrast, the utilization of hybrid power generation faces a number of challenges, which cover:

- Subsidy policy for fossil energy.
- High investment cost
- RE technology mostly must be imported.
- Insufficient data on RE potentials.

CONCLUDING REMARKS

The utilization of hybrid power generation systems offers an alternative solution in producing competitive, sustainable, and environmentally friendly electrical energy. The revitalization of the hybrid system is a

solution to substitute fossil fuel in generating electricity, hence reducing global GHG emissions.

RECOMMENDATIONS

- Detailed study and analysis of potential resources are required before carrying out a RE project.
- Determination of basic specification and engineering standards for energy conversion technology that is suitable for the Indonesian condition.
- Reducing investment cost by production intensification in Indonesia.
- Provide a priority on the RE development in the areas with high potential of resources and socio-economics.
- Capacity building on the applied technology for the operators and management is required to maintain the continuity of the equipment operation and network reliability.
- Socialization on the applied RE technology is important to promote environmental protection for a successful implementation of the RE generating system.
- Provide financial incentive for RE development

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