WIND ENERGY FOR VILLAGERS TO REDUCE POLLUTION AND THE USE OF FOSSIL FUEL

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Abstract

Wind energy potential in Indonesia is about 450.000 MW. The Heritage Bogor Foundation (HBF) is trying to contribute the use of renewable energy by introducing wind energy technology. The project has been starting since 2003, to conduct a research and development of wind energy technology for water pumping/ irigation and village electricity. The designed windmill was made as simple as possible and used local materials to make it affordable. This paper described wind data collection in the targeted area, the development stages and the benefit analysis for villagers.

Key words: EGRA, Indramayu, irrigation, village electrification, wind energy potential, windmill.

Abstrak

Potensi energi angina di Indonesia adalah sekitar 450.000 MW. The Heritage Bogor Foundation (HBF) mencoba memberi kontribusi dalam memanfaatkan energi terbarukan dengan memperkenalkan teknologi energi angin. Proyek dimulai sejak tahun 2003, untuk melakukan riset dan pengembangan teknologi energi angin untuk memompa air dan pelistrikan desa. *Windmill* didisain sesederhana mungkin dan menggunakan bahan lokal agar terbeli. Makalah ini juga menguraikan pengumpulan data angin didaerah yang disasar, tahap pengembanagan dan analisa keuntungan bagi masyarakat desa.

Kata kunci: EGRA, Indramayu, irigasi, listrik pedesaan, potensi angin, kincir angina.

1. INTRODUCTION

Indonesia archipelago has 17,508 islands with 81.290 km coastline length. From 17.508 islands, 5.700 islands have names and 992 islands are populated. These island are distributed widely from Sabang in Aceh Province until Merauke in Papua Province.
Five big islands are Kalimantan, West Papua, Sumatera, Sulawesi and Java, while the rest are small islands. The characteristic of small island is poor resources, lack of freshwater and electricity supply due to its geographic condition. To build freshwater facilities and electricity are very expensive and also its maintenance is costly due to the limited human resources. These situations and many other constraints make small islands are less developed. Therefore, need the huge efforts for development. Monetary crisis since 1997 increase the burden and losing capital for development.

Energy consumption increase following the population. Until 2003, there is electricity shortage of about 3000 MW and about 2.5 million people in waiting list to get electricity. More than 80% of Indonesian electricity power is produced by using of fossil fuel (Indonesia Energy Outlook 2005).

More than 40 million people life below the poverty line and most of them are living in rural area with no electricity. The electricity ratio in Indonesia is very low only about 54%, this means only 54% of families in Indonesia have electricity in their house. The government has target to raise the electricity ratio to 95% by 2025. The government regulation no. 5/2006 says that in 2025 renewable energy usage should reach 17% and the wind energy application has to reach target of about 250 MW

Diesel oil is widely used to generate electricity in small islands.
On the other hand, Indonesia has very high wind potential for almost 450.000 MW. This great potential has been used very little. Wind energy is one of renewable energy and clean, however, need conversion system named as wind turbine to convert its kinetic energy. The wind turbine can generate the electricity for common use and could replace a high cost diesel fuel for generating electricity. The use of wind energy could replace and reduce dramatically the use of fossil fuel as a source of energy in rural area especially for water pumping and electricity generating for rural people in Indonesia.

The Heritage Bogor Foundation (HBF) is trying to contribute to solve this energy problem through an introducing and socializing the use of wind energy as an alternative energy and trying to make more people understand about the benefit of using wind energy. The socialize program is important as people have to know that wind energy is relatively simple and easy to handle and can be use for everyday life. The HBF is willing to promote the use of wind energy for water supply and electricity in Indramayu and several areas in Indonesia in order to archive the use of diesel oil in small islands.

2. PROJECT DESCRIPTION

2.1. The objectives

The objectives of this project are:
1. to show high potential wind energy in Indonesia and introducing an affordable wind energy technology,
2. to demonstrate that using a cheap and low cost energy technology will reduce production cost,
3. to socialized that using wind energy in daily life means give a contribution to environment as wind energy is a non polluted resource.
4. to contribute poverty alleviation in Indonesia,
5. to develop windmill that use local materials and suitable to local wind characteristic,
6. to reduce the dependency on fossil fuel.

Another objective is to influence the stakeholder to improve economic competitive by cutting the energy consumption cost. The use of wind energy can generate economic activities, several advantages are to raise income, a better post harvest processing especially for export.

The project has been starting since 2003. This project is combining a research on an alternative energy resources and an effort to introduce a sample of wind energy technology for rural people and test them. This windmill is providing farmer with a simple and affordable wind energy technology for water irrigation. With this technology farmer could receive direct benefit from a reduced cost in providing water for daily used and land irrigation.

2.2. Wind energy potential.

A research to investigate wind energy potential was done using in situ method and wind speed measurement equipment to know wind direction as well as chart eristic in some areas in Indonesia. The result will be used to consider the further wind project.

The wind speed at some areas have been investigated by The Heritage Bogor Foundation in 2003 to 2005, those are West Java province at six locations, South Sumatra at 2 locations, Central Java at 1 location and NTT at 1 location. A preliminary result of this research surprising, the wind energy potential is promising.

The measurement of wind speed in Indramayu was starting from July 2006 to February 2007. Anemometer is used to measure the wind speed every hour, three times data recording in 5 minutes. The result of this measurement is given in **Fig. 1**, it shows a wind speed of more than 5 m/s. The wind blows faster in dry season than in rainy season. One interesting point is the wind is blowing in almost 17 hours a day
The designed windmill could start turning in the wind speed of 3 m/s, so the collected wind speed data is rated good and useful as energy resource.

2.3. Engineering Innovation.

The innovation design of windmill and its development technique are elaborated to ensure that the windmill design: blade, mechanical, pumping and others are suitable and affordable to use in Indonesia. It starts from setting up the management, designing, revising the design and commissioning test.
In 2003 to 2005 the foundation had successfully in developing

- windmill of 1kW capacity for water pumping of about 3 liter per second
- windmill of 10 kW for electricity generation in order to give a contribution to the government village electricity program

Consideration on materials used rise a conclusion that the material used should be widely available in local market. The design should be as simple as possible and easy to maintain. Simple design using widely availability material raises a possibility to reduce the cost so that people could afford it.

The first windmill of 1 kW capacity was installed in Darawolong village, Karawang, West Java in March 2004 for water irrigation (Mohamad Nashar, 2007). Previously, the Darawolong's farmers face water scarcity in dry session, therefore they could not plant rice. They used diesel engine for water pumps to irrigate the rice plantation. The windmill was installed in the middle of the rice plantation to carry water from the well.
Following this first windmill, a further research is directed to develop windmill for generating electricity of 10 kW capacity. This design has been finished and installed in Indramayu for field test. These windmills were designed and developed to suit the wind characteristic. The name of this windmill is EGRA or Energi Gratis (free energy)

Fig. 1 Weekly average wind speed data in Indramayu

2.4. Socialization and Publication.

Presentation, seminar, and workshop to introduce this wind energy technology is exerted. It has been starting since 2003 with several presentations to stakeholders, conduct a workshop and seminar to introduce and socializes the wind energy project, the installed wind energy technology, available wind resources, potential and how to utilize it. This stage also includes training among the various users.

The wind energy technology seminar with theme "wind energy as a new opportunity" was conducted on 28 - 29 March 2007 in cooperation with BTCO as an organizer.
Around 100 participants from various backgrounds has attended in this seminar.
The network using electronic mailing address: energi-angin@yahoogroups.com has been growing to be 300 members

Fig. 1 10 kVA EGRA windmill

Fig. 2 Inverter equipment .

Fig. 3 Batteries

Fig. 4 Travo.

Fig. 5 Electric stabilizer

3. ENGINEERING RESEARCH

The Heritage Bogor Foundation has developed new engineering approach.
The wind characteristic in Indonesia is fairly low compare in other country, which has relative high wind speed. Therefore, the imported windmill cannot work well in Indonesia, The HBF designed the multi blade windmill to maximize the wind swept area made the multi blade could work in a relative low speed wind.

The kinetic energy of wind is transferred to the AC Generator. From the Generator the energy is store in Battery after synchronizing from AC to DC.

The current work of the project is improving capacity of the Generator from 10 kVA to 15 kVA and start to test the capability of this generator. The result shows that the most efficiency power is on 1400 rpm
To stimulate we use low voltage between 100 to 150 volt and using Automatic Voltage Regulator for 220 volt. From AVR the electricity will run battery charger and save into battery (DC). If the AC is needed the system will use Inverter to convert DC to 220 AC

4. BENEFIT ANALYSIS

4.1. Decrease Operating Cost

The 10 kVA windmill produces about 15.000 watt, in peak time, and has efficiency factor for about 50%. Operating cost to generate 10.000 watt out of the windmill system that use regular electric or generator set is around 12 million rupiah per year or 33333 rupiah daily. If using the diesel engine to generate 10.000 watt, this engine will consume 2.7 litter of diesel per hours or 11.610 rupiah/hour or 278.640 rupiah daily.
Using 10 kW windmill will reduce the operation cost until 90 % of that needed to operate the diesel engine. This also means eliminating the use of fossil fuel.

PLN selling price is Rp.450 per kWh.
Comparing to this price, the villagers could save about US$ 2400 per year if they use wind as an energy resource to generate electricity.

4.2. Reduced CO_2 Emission

Refocus Weekly Magazine (Nov.8, 2008) described if each family using 750 kWh per month from renewable energy resource, this means each family contributes not-burning 561 pounds of coal and not-releasing 1044 pounds of CO_2 into atmosphere.
The windmill of 10 kVA capacity generates 7200 kWh per month. This means, the use of wind energy have reduced the emission of about 68,74 kg daily

The HB foundation has made a study on the use of daily fossil fuel in Rancasari Village. The villagers consume about 250 liter of kerosene per day. This amount matchs to the data gathered from some kerosene sellers in Rancasari. With almost 6000 population, this means that each individual consume about 0.41 liter per day or 1000 rupiah per day

The foundation had met the Secretary of Rancasari Village Office, the Head of 'dusun', the Bekel and some government officers in this village. They gave supports to the program and they propose to use windmill for water irrigation in the near future.

5. CONCLUSION

The usage of wind energy in Indonesia is still small. This can be increased in the future as Indonesia has a huge potential of wind energy of about 450.000 MW.
Consider that the wind condition in Indonesia, The Heritage Bogor Foundation has developed the design of windmill to match the local wind speed condition and using local materials to match the local ability to buy.
The wind energy socialization such as seminar, workshop and presentation will be conducted in the future to introduce the benefit of using wind energy to substitute fossil fuel

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