

**HIGH ACADEMIC INSTITUTION ROLE'S IN THE  
DEVELOPMENT OF RENEWABLE ENERGY IN  
INDONESIA**

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# HIGH ACADEMIC INSTITUTION ROLE'S IN THE DEVELOPMENT OF RENEWABLE ENERGY IN INDONESIA

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## ABSTRACT

*Potency of renewable energy in Indonesia has enough large values, The development of renewable energy is dominated by government institution, which the academic institution role's in the developing renewable energy still very low, college institution in playing an important role is very necessary in the research and the development of renewable energy, in order to support renewable Energy human resources capability in Indonesia in the future. At this so far, the implementation of renewable energy has been spread out almost in the region of rural areas in Indonesia, which is not connected in to PLN grid. In order to support the research and the development of renewable energy in Indonesia, the college institution active role's in Indonesia is very important things.*

## 1. BACKGROUND

New energy and renewable energy is a clean energy, so it is no doubt that renewable energy can be added in to the criteria as the future energy. Some development countries like Germany and Denmark has changed their electricity development strategy with making renewable energy as the main priority to supply electricity demand for their energy consumptions through reducing the energy consumptions from nuclear energy and Diesel Generators.

Based on the renewable energy database that developed by BPPT- UNESCO in the year of 1999/2000, it is known that the potency of renewable energy in Indonesia if it's developed seriously, it can supply energy consumptions in Indonesia. Because the capability of human resources in renewable energy technology that owned by the experts in Indonesia is still not optimal, so that renewable energy development still seemed hit and run. There is only small the example of the development and implementation of renewable energy that can be predicated as a success project. Even in some locations is still nearly failed project. The concept of renewable energy development that applied in Indonesia is using Top Down concept which it has negative impact in the management of renewable energy in Indonesia, even based on the experience in some developing countries that applied this Top Down concept if it's managed professionally, it will be failed. Generally, the renewable energy technology that developed in the world is a modern technology, so that the compatible and qualified human resources support is very necessary. Because of that case, the college institution role's is very important in giving the contributions in the qualified human resources development in renewable energy in the future. At this so far, the number of the experts in renewable energy in Indonesia is still very little. This will give an impact to the renewable energy development in Indonesia. There is a lot of professional experts from the other sciences who feel expert and capable in developing renewable energy in Indonesia, so with the 24-year lifecycle's of the implementation of renewable energy in Indonesia can not give the satisfaction and optimal results, even the implementation statues of some renewable energy type until now is still in Pilot Project.

Renewable energy development concept in Indonesia must be mapped by the professional expert who has capability and qualified based on their field of achievement, thus the role of government institution in collaborating with the college institution to create professional expert is very compulsory. The involving of the college institution in focusing the concentration of research and development in renewable energy technology is also needed. In the next future, renewable energy development concept in Indonesia will give an optimal result, which comes from the collaboration between government institution and the college institution.

The potency of renewable energy consist of Micro hydro energy, wind energy, Solar energy, Biomass energy, Ocean energy and Geothermal energy which is very potential to be developed in Indonesia since renewable energy is clean energy and does not result green house gas emissions, thus the involving of the all institutions in supporting the development of renewable energy in Indonesia is very compulsory.

## **2. RENEWABLE ENERGY POTENTION IN INDONESIA**

Some of the developed countries begin to increase renewable energy consumption especially in Germany which is 25% from its energy consumptions came from Wind energy for the planning strategy in 2005, while Denmark is more ambitiously with targeting 50% of their energy consumptions come from Wind energy. It is achieved by reducing energy consumptions from nuclear energy and fossil fuel energy.

### **Micro Hydro Energy Potentials**

Potency of hydro energy in Indonesia is approximately reaching 75 GW. With the biggest potential located in Irian Jaya island is less than 30 GW, Borneo island is 29 GW, Sumatra island is 20 GW, Celebes island is 14 GW, Java island is 6 GW and the rest located in the other island. While the biggest potential of micro hydro located in the province of West Sumatra, Bengkulu, West Borneo and Middle Celebes with the total capacity of micro hydro potential in Indonesia is about 458,75 MW.

Micro hydro Generator has been produced by the professional expert, even the micro hydro is made by some industries and social organization or foundation related in the human resources development in Bandung has been exported in the foreign country. While the reality of technology is not yet achieved, it has obstacle in the system control of micro hydro generator is still not optimally achieved. The micro hydro technology that developed in Bandung has received the licensing from German Product (GTZ-Germany).

The Indonesian expert must achieve Microhydro generator technology in the future rapidly, thus the micro hydro potential in Indonesia is enough large.

At this so far, the installed capacity of micro hydro has reached 21 MW, and it spread out in Indonesia, while not all of them can operate. The main obstacle faced by the micro hydro generator development that micro hydro generator technology is a simple

technology; the other problem came from the operational & maintenance and management factor.

### **Geothermal Energy Potential**

Indonesia is a country that has the biggest of geothermal potential in the world. 40 % until 43 % from the geothermal potential in the world is located in Indonesia.

As volcanic area, Indonesia territory is rich with the source of geothermal energy; the potency of renewable energy in Indonesia is about 19.658 MW. Almost half (8100 MW) of this potential is located in Java island and Bali, Sumatra island potential is 4.885 MW the rest is located in Celebes island and the other island.

Geothermal has several advantages, which is not owned by fossil fuel energy. It's renewable and clean energy.

### **Wind Energy Potential**

Wind speed measurement in Indonesia is implemented by the institution of BPPT (10 locations), LAPAN (52 locations) and BMG (71 locations) with the height measurement between 10 meters until 24 meters. Ideally, the wind speed measurement is up to 24 meters until 50 meters to get the potential and constant wind speed.

The annual average wind speed in Indonesia is approximately between 2 m/sec until 7,5 m/sec, with taking the minimal values of wind speed to be used is 3 m/sec. The installed capacity of wind energy that can be implemented in small scale is about 10Kw. Wind speed measurement's locations in Indonesia is still not optimal in the whole region in Indonesia which is expected in the next future will be lot of wind speed measurement that is represented each island in Indonesia, so that it will obtained wind speed mapping in the whole region in Indonesia.

Wind energy generator in Indonesia still in the level statues of Pilot Project, and the implementation is not optimal. If it looked from the history of the wind energy development in Indonesia has been long time intensively applied by LAPAN since 1979. Most of the components of wind energy generator is imported from foreign countries. The biggest pilot project of wind energy generator in Indonesia is located in Jepara, Middle Java with the installed capacity is 84 KW.

### **Biomass Energy Potential**

Irian Jaya island has the biggest biomass/solid waste potential (6,8 GW), then followed with East Java (5,4 GW), Middle Java (4 GW), West Java (3,7GW), East Borneo (3,2GW), Middle Borneo (3 GW), South Celebes (2,5 GW), North Sumatra (2,4 GW), West Borneo (2,2 GW), South Celebes (1,8 GW), Lampung (1,7 GW), Riau ( 1,6 GW), Aceh (1,3 GW), the province like West Sumatra, Jambi, South Borneo, Middle Celebes, East Nusa Tenggara and Maluku each has 1 GW and the other province has solid waste potential below 1 GW.

Biogas energy potential map came from buffalo, ox and pig dirt can be met in the whole region with different quantity. The province of East Java has the biggest potential of biogas energy with the capacity is about 125,9MW.

The biggest Peat energy potential located in Sumatra Island, Borneo island and Irian Jaya island with the variation thickness. In the remote Sumatra, Peat thickness can reach 17 meters and it generally only 4 meters thickness in the offshore. Based on the research from the directorate of coal (Directorate energy and mineral resources), the potency of Peat energy in Indonesia reach 97,9.  $10^{12}$  MJ (Mega Joule). The biggest potency is located in Riau: 39.  $10^{12}$  MJ (Mega Joule).

Gasification technologies have been operating in Indonesia through PT Pindad based on the licensing from foreign country. There are many places that has implemented gasification technology, include Irian Jaya island, Borneo and a pilot project made by LSDE – BPPT in Serpong. Because of the problem of technology that is not efficient and has lower price, make gasification technology in Indonesia can not be well developed.

Biogas technology in Indonesia has been well developed since 1970 until 1980. Principally, this technology had achieved by the Indonesian expert, there are lot of variants of biogas technology, which has reach, its development in the world especially the technology made from rubber that developed in Germany, India, China and Nepal. This biogas technology can't receive by Indonesians who live in villages because there is the other energy, which is simpler and cheaper like burning wood.

### **SOLAR ENERGY POTENTIAL**

Indonesia has average of daily solar radiations 4,8 kWh/m<sup>2</sup> with the biggest potency located East Nusa Tenggara, based on the solar energy map, that the whole area in Indonesia has good potency to develop Photovoltaic Generators.

The development of Photovoltaic Generator in Indonesia is quite rapidly, especially Solar Home System (SHS), which has been spread out in several provinces in Indonesia. The main components of Photovoltaic Generator technology is still imported from foreign country, especially solar modules, while the additional components such as BCR (Battery Charge Regulator), TL lamps, Cable, Battery and the other has been capable to be produced in Indonesia. Even though, the cost of the whole additional component is very low, while dependency from the import component is still very high.

Total of installed capacity of solar energy in Indonesia has reach 4 M Wp and it's implemented in the whole rural area in Indonesia.

### **Ocean Energy**

Ocean energy can be classified in to three types; those are OTEC (Ocean Thermal Energy Conversion), Tidal energy and Wave energy.

### **Ocean Thermal Energy Conversion**

Based on Our ocean area that almost 70 % surrounded by the sea is enough potential for the development of Thermal Energy, with the potency of thermal energy  $2,5 \times 10^{23}$  Joule and the efficiency 3% are able to produce power about 240.000 MW.

### **Tidal Energy**

Potency of tidal energy is enough potential especially the region with seawater tidal more than 5 meters can be met in the half of Sumatra regions, Celebes, West Nusa Tenggara, Kalimantan, Irian Jaya and Java beach island.

### **Wave energy**

Wave energy is the other type of ocean energy, which this last year is, begins to be considered. Wave Energy is the other type of ocean energy, where for the last this year is getting to be considered in order to implement as a potential alternative energy which to be developed in Indonesia. Wave energy has good prospect in the future, for instance that wave has 2 meters until 3 meters height and able to generate electricity 39 KW per wave length.

Based on potential renewable energy resources that informed above if it mapped, almost every region has potency 3 – 6 type of renewable energy resources. If this potential of renewable energy resources integrate applied, so dependency on fossil fuel energy can be reduced.

While renewable energy technology such as Geothermal, Ocean energy and the others still imported from foreign country, this technology development has been commercially developed in the worldwide, and it has been used by PLN to generate electricity in Indonesia.

## **3. HIGH ACADEMIC INSTITUTIONS ROLE'S IN THE DEVELOPMENT OF RENEWABLE ENERGY IN INDONESIA**

College institution is the last academic institutions from the formal education which implements the function of Tridharma of high academic education as the continuity from middle education accomplished in order to prepare generation to be member of citizen that has the academic ability and professional to apply, to develop and to create knowledge.

High academic institution must be able to answer the challenge and global rapid changes for instance to make relevant between educations programmed with market needs. High academic institution should be responsively with the conditions that give an impact to the future market, like professional expert in the renewable energy. The condition of High academic institution in Indonesia right now is still not focusing in the segments necessity in renewable energy.

Government institutions extensively authorize research and Development (R& D) in renewable energy, even private sectors/NGO (Non Government Organization) who has authorized several types of renewable energy such as Micro hydro energy. College institution role's in Research and Development of renewable energy is very minimum; The involving of high academic institutions is limited only in "fit and proper" study. Unfortunately, high academic institution as place that lead the main command in Tridarma of high education should be responsively to the development of renewable energy as an future alternative energy. On the other hand, weakness in Research and

Development of renewable energy of the high academic institution should not be consider because of several factors below:

- a. Renewable energy is a new knowledge in Indonesia, even though several universities in Indonesia have implemented one type of renewable energy such as Micro hydro in the last years.
- b. There aren't human resources in supporting the experts in renewable energy in the university.
- c. Renewable energy development in Indonesia is not yet promising, so that the segment in renewable energy is not the main priority in studying programmed.
- d. High academic institutions are still considered that Indonesia has not yet clear programmed in developing renewable energy on the national electricity maps.
- e. Field laboratory's facility in renewable energy (for instance renewable energy laboratory's park) is still very expensive.
- f. Research and Development of renewable energy is still dominated by government institution such as BPP. Technology, Lapan, DJLPE and LEN-LIPI.
- g. There isn't any coordination between government institution and high academic institution in research and development of renewable energy in Indonesia.

Based on the several factors above, it seemed that it influence high academic institutions in Indonesia not attracted to develop renewable energy as a new education program.

In several universities in Indonesia, there are some basic lessons that learn the basic theory of renewable energy, even though it still cannot create expert in renewable energy. In the few years ago, there is university (Universities of Gajah Mada) which is concentrate in the type of renewable energy for graduated program (S2), which majoring in Micro hydro, even it seemed from its curriculum is still not be able to answer professional expert that is needed.

In several universities in foreign country has been good concept in supporting research and development of renewable energy in national level, even in International event. Every high academic institution is installed with complete field laboratory facility (Micro hydro generator, Solar Energy, Biomass energy, Wind energy and the others) and there is strong relationship for government institution who developed research in renewable energy, so that high academic institution be able to produce professional expert.

Based on the potency of renewable energy in Indonesia, high academic institution in Indonesia should be determine to open study program concentrating in renewable energy to support national renewable energy program, where the autonomy region, renewable energy will be attractively, while promising clean energy. The energy came from renewable energy is the future energy in order to substitute fossil fuel energy such as Diesel Generator.

To support human resources in renewable energy in Indonesia, several beginning step that must be applied by high academic institution in making study program of renewable energy is listed below:

- a. To implement the expert from government institution.



- b. To develop the cooperation with the government institutions who has field laboratory facility in renewable energy.
- c. Planning the development renewable energy park and cooperate with high academic institution from foreign country or local region government.
- d. To create a good concept in the developing of renewable energy, which does the expert from multi discipliner, integrate.

Based on the result of evaluation and monitoring implementation of renewable energy, it can be identified some weakness in the development of renewable energy as global below:

1. The investation of renewable energy is expensive; most of the components is still imported.
2. Renewable energy technology authority is still not optimal because there is no transfer technology.
3. The guarantee of operation and maintenance is low because of the limitation of the availability in spare part.
4. People participation role's is still quite low because almost most of the technology implementation model using Top-down system.
5. Renewable energy policy is not able to attract Investors and Private sectors in supporting the development of renewable energy.
6. Management and operation system is not professional which it will give an impact to the investation return system and failure.
7. Infrastructure supports from center government or local government is not optimal.
8. Incentives or subsidy given by the government institution in development of renewable energy is quite low, if compared by the beginning investation.

According to the several obstacle above, the government institution role's should give the right solutions in order to answer some problem which may happens above. There are also several important matters to be consider by high academic institution to support the development of renewable energy in Indonesia, as listed below:

- a. Renewable energy can be category as consumptive necessity if renewable energy utilization is only used for lighting, this type of the energy technology is Solar home system which is can be priority only to supplement lighting from oil fuel. And it implemented in rural area and spread out with decentralization systems.
- b. Renewable energy can be category for consumptive and productive use, if energy consumption beside lighting use, it can also apply for productive activity, and usually for the capacity up to 20-30 KVA. Renewable energy technology can be designed with individual system for instance like Micro hydro or hybrid system (solar energy and diesel generator, Wind energy and diesel generator, Solar energy and Micro hydro, diesel generator, Wind Energy and Solar energy)
- c. Renewable energy can support energy Saving, as known that almost potency of renewable energy can be sell and become useless before it changed to be electricity, thermal energy and mechanical energy. For example the

- implementation of energy saving with using renewable energy through supplying heat water from Water Heater with Solar Collector,
- d. Renewable energy can support national power grid system as the implementation of wind energy on the national utility grid Germany or Denmark. On the other hand, grid connected system in the future, not only dominated by wind energy but also the other renewable energy like Solar energy, Micro hydro and the other.

#### **4. REKOMENDATION**

Potency of Renewable energy very big enough and spread over in all Indonesia. Potency of Renewable energy cannot be sold, but can be converted into form of energy other for example electric, hot, mechanic etc. Research and development of renewable energy which have taken place more or less 24 year in Indonesia, but not yet can move University in Indonesia to involve active in it. Role of University very needed to support to research and development renewable of energy in Indonesia, for that there are some important point to increase role of University in Indonesia:

1. Creating cooperation research into and development between University with institution Research of Government which have previous active with area of renewable energy in Indonesia
2. Founding study program in the field renewable of energy by exploiting Human Resource of Institution Governmental which is active in the field renewable of energy.
3. Cooperation of Institution Governmental and or institute of research from outside country for development of park renewable energy to support development and research in area of renewable energy in Indonesia

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