GEOTHERMAL ENERGY: BEST SOLUTION TO REDUCE EMISSIONS IN INDONESIA[1]

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Abstract

Environmental issues have become a big issue in the world. It's associated with the development in a globalizing world that focuses on research related to human needs, namely the field of industry, technology, and energy. The challenge ahead is how to advance these fields without forgetting the environmental aspects. Environmental issues are certainly felt by all countries in the world, not least in Indonesia. Indonesia is a country located in the subduction zone. This makes Indonesia have large energy reserves, reserves of fossil energy such as oil, gas, and coal, and also non-fossil energy such as geothermal energy, water, wind, and sun. Even the mineral wealth is very abundant in Indonesia. Its growth was very significant. However, progress in the field of energy development cause new problems, namely environmental issues. Due to the fact that Indonesia is still very dependent on fossil energy, especially oil. Carbon emissions resulting from fossil energies have an impact on the environmental conditions in Indonesia. Geothermal is one form of energy available in Indonesia are a number of very abundant. This energy is well-known environmentally friendly, renewable and sustainable. Geothermal energy can be an alternative solution for the independence and energy security in Indonesia without forgetting the environmentally friendly.

Key words: Carbon Emissions, Geothermal Energy, Environmentally Friendly

Introduction

Indonesia is a country consisting of many islands, more than 17.000 islands of Indonesia are in the area ranging from large islands and small islands. Indonesia also has a unique geographical position and make it strategic. This can be seen from the location of Indonesia which is located between two oceans and two continents at once to make Indonesia as a center of trade in the world. Beside that, Indonesia is also known as a country that has a rich abundance of natural energy. Location of Indonesia who are in a zone of collision of tectonic plates making Indonesia has large reserves of energy for survival in Indonesia itself and for the survival of the world, ranging from fossil energy reserves such as oil, natural gas, and coal, to non-fossil energy such as geothermal energy, water, wind, and sun.

In tectonics, the position of the Indonesian archipelago is on track plate collision zone. Collisions between the plates led to the formation of a series of volcanoes that extends from Sumatra, Java, Nusa Tenggara, and Sulawesi to the Moluccas. Because of these collisions, the flow of heat from the bowels of the earth can reach a position relatively close to the surface of the earth. With that position causes Indonesia has geothermal potential 27 GW, equivalent to 40% of geothermal energy reserves in the world.

But unfortunately, natural resources abundant in Indonesia are still causing an energy crisis for the State of Indonesia itself. Until now, even, Indonesia still imports 277.000 barrels of crude oil per day and fuel oil (BBM) of 407.000 barrels per day in the 2010. Indonesia reinforces the fact that the country is still heavily dependent on fossil energy, especially oil, where the more limited number in the world and the results aren't environmentally friendly combustion. In addition, the electricity crisis in Indonesia and the weather is unpredictable right now is an indication that the energy crisis and the impact of energy use in Indonesia can't be underestimated again. Therefore, the need for an environmentally friendly alternative energy and abundant energy reserves and also renewable in order to avoid an energy crisis and pollution everywhere.

Geothermal energy is one form of energy available in Indonesia in a number of very abundant. This energy is well-known environmentally friendly, renewable, and sustainable. In the process of exploration, geothermal doesn't require land surface that is too big. Geothermal energy is not even this can be exported; it's very suitable to meet the energy

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needs in the country, so that this energy can be an alternative solution for the independence and energy security in Indonesia.

Model, Analysis, Design, and Implementation

Definition Of Geothermal

Geothermal consists of two syllables is, "geo" means earth and "thermal" means heat. Geothermal energy is the energy source that is produced when water falls from the surface of the earth met the magma (molten rock in Earth's crust is very hot) extremely high levels of heat that rises from the bowels of the earth. This meeting lead to a hot fluid that has the power to be used as energy**.** (*Asosiasi Panas Bumi Indonesia, 2004:15*)

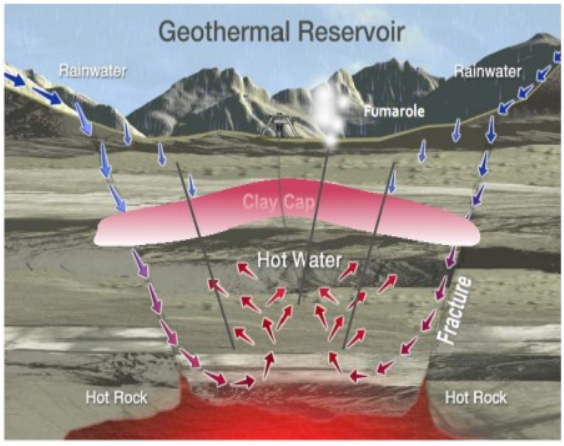

Figure 1. Geothermal System

This heat energy contained in fluid water which is at a depth of more than 1 km below the earth's surface. The hot fluid has a high temperature and pressure and some even have a temperature more than 300^{0}C. Geothermal energy has a system called geothermal systems. Geothermal system is a system comprising: a hot rocks at depths of more than 3 km, rock fractures containing fluid (located on top of hot rocks), and rock which is usually a clay alteration (which cover the reservoir). Geothermal systems can be categorized based on the temperature of reservoir and fluid phase in reservoir. System geothermal reservoir can be categorized based on temperature and fluid phase in the reservoir.

Geothermal systems can be categorized based on reservoir and fluid phase temperatures in geothermal reservoir. System can based on the magnitude of the temperature; Hochstein (1990) distinguishes geothermal system into three, namely:

1. Low-temperature geothermal systems, namely a system with a reservoir containing the fluid temperature is less than the fluid with a temperature less than 125^{0}C.
2. Middle-temperature geothermal systems are a system which contains a fluid reservoir temperature of 125^{0}C to 225^{0}C.
3. High-temperature geothermal systems, a reservoir system containing fluid temperature above 225^{0}C. Based on the temperature of the reservoir and fluid phase in the reservoir.

Geothermal systems are often also classified based on the enthalpy of the fluid, namely a low enthalpy system, medium enthalpy system, and high enthalpy system. Criteria used as a basis for classification, in fact not based on the value of enthalpy, but based on the temperature since the enthalpy is a function of temperature. Based on the fluid phase that is in the reservoir, geothermal system is divided into: geothermal single-phase systems and geothermal two-phase system.

Geothermal system is usually a single phase liquid phase, while the two-phase geothermal systems can be divided into a hot water dominated geothermal systems and vapor dominated geothermal systems. The number of geothermal systems in the world dominance of the steam is very little. Below are described some of the geothermal power generation system:

1. Dry Steam Power Plant

The power plant of this type, used steam directly from the wells that produce steam dry steam flowed directly into the turbine and the turbine then spins and then turns a generator producing electricity. This conversion system is a system of conversion of the simplest and most economical. Steam from the turbine can be discharged into the atmosphere. From the condenser, condensate water then flowed into the cooling tower which subsequently injected into the subsurface of the earth. Some of the condensate water is channeled into the condenser.

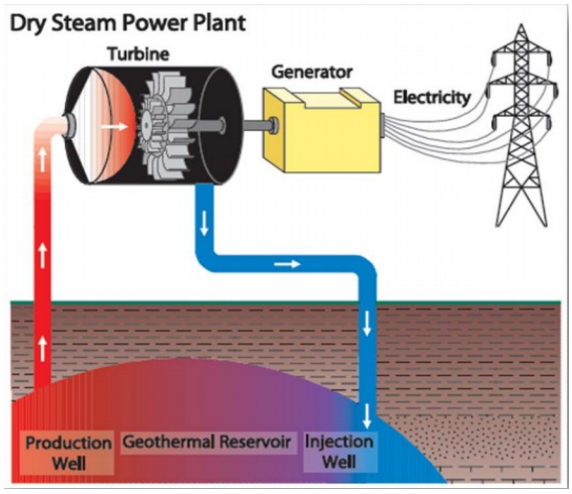

Figure 2. Dry Steam Power Plant

2. Flash System Power Plant

The plant species used in the geothermal fluid is liquid and high temperature. Liquid fluid is inserted into the "flasher" so it turns into vapor phase. Highly dependent on the amount of vapor pressure flasher. Fraction of steam is then channeled to the turbine.

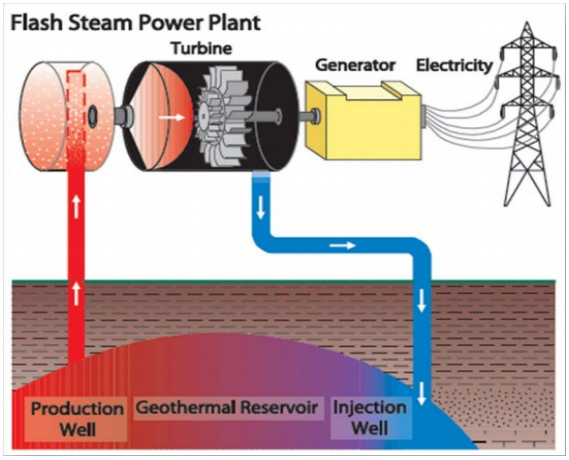

Figure 3. Flash Steam Power Plant

3. Binary Cycle Power Plant

If water reaches the surface isn't hot enough to produce steam, then the hot water can still be used to generate electrical energy by passing hot water to the "Binary Power Plant". Hot water is supplied to the engine heat exchanger (heat exchanger). The heat from the water absorbed by a liquid such as isopenthane then used to turn turbines, generating electrical energy. Substance isopenthane then condensed back into liquid state and then reused

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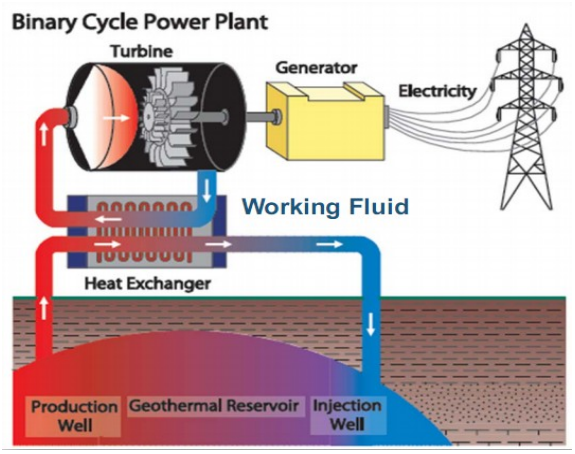

Figure 4. Binary Cycle Power Plant

The Potential of Geothermal Areas in Indonesia

Geologically, Indonesia is located on three main tectonic plates, the Eurasian plate (Europe-Asia), the Australian plate and Pacific plate. Confluence of three tectonic plates results in the occurrence of collisions that lead to the emergence of volcanoes in Indonesia are usually known by a belt of volcanic mountains or ring (ring of fire). There are mountain ranges extending along the western island of Sumatra and constantly up to Java, Bali, Nusa Tenggara, Sulawesi and then to turn to the west and Papua.

Geological conditions thus provide a clear picture of the potential of geothermal energy in Indonesia. Amount of resources and geothermal energy reserves in Indonesia as a whole at 27.000 MWe. A very large number and is the largest in the world (40% of world reserves). The amount of energy can be used to meet electricity demand in Indonesia.

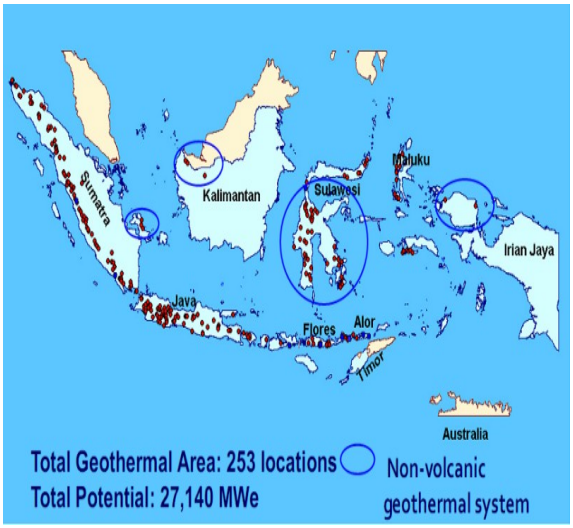

Figure 5. The Potential of Geothermal Areas in Indonesia

The Advantages of Geothermal Energy

Geothermal energy has advantages compared with other types of energy, some of them are renewable energy. The results showed that the use of every 1 MW geothermal power plant is expected to save on fuel consumption equivalent to 45 barrels per day.

In addition to these advantages, geothermal energy has other advantages not shared by other energy sources are relatively more environmentally friendly because they don't spend a lot of harmful gases when compared with other energy such as oil and coal. Emissions of environmentally friendly geothermal energy makes geothermal has the opportunity to utilize the Clean Development Mechanism (CDM) product kyoto protocol. This mechanism stipulates that developed countries should reduce greenhouse gas (GHG) emissions of 5.2% against 1990, may be through the purchase of clean energy projects in developing countries are built on 2000. Clean energy including geothermal energy.

Geothermal energy is environmentally friendly because of the geothermal fluid after the heat energy is converted into electrical energy, the

fluid is returned to the bottom surface (reservoir) through injection wells. Injection of water into the reservoir is an obligation that must be done to maintain the balance so that slow the decline in reservoir pressure and prevent subsidence. Re-injection of geothermal fluid after the fluid is utilized for power generation, as well as the see page of surface water makes geothermal energy

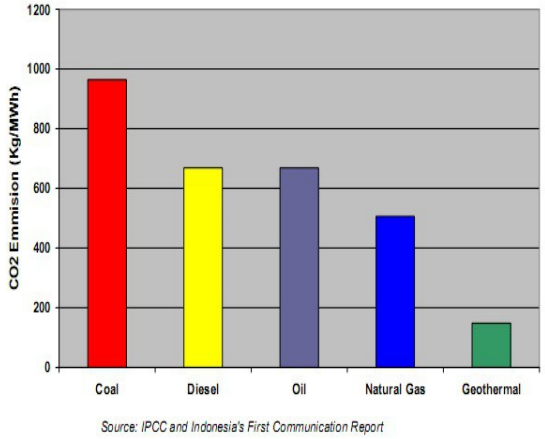

Figure 6. Comparison Graph of CO_2 emissions from various energy sources

This can be seen from the CO_2 emissions of only 170 kg / MWh. A relatively small amount when compared to the CO_2 emissions from coal energy is 980 kg/MWh and natural gas 500 kg/MWh, while fuel oil (BBM), mainly diesel and fuel oil has a CO_2 emissions are between 670 kg/MWh and 680 kg/MWh. This means that geothermal energy has a smaller level of pollution compared to fossil fuels.

Another advantage of this geothermal energy is the price of the lowest electricity production. The use of geothermal energy has been trusted more cost effective. That's because there was no need for unexpected costs and expenses other negative externalities that exist in the utilization of fossil fuels. For power plants with a capacity of 250 MW, has found a formula that calculated the environmental cost of coal at U.S. $ 48 million per year, gas was U.S. $ 17 million per year and geothermal reached U.S. $ 0.399 million per year (Pertamina, 1996)

Result

The potential of geothermal energy in Indonesia is no doubt magnitude. This can be seen from the geothermal resources are scattered throughout the territory of Indonesia starting from the island of Sumatra, Java, Nusa Tenggara, Sulawesi to the Moluccas. With a total potential of about 27 GWe, Indonesia is a country with the largest geothermal energy potential in the world.

However, the utilization of this abundant resource can not be utilized by the Indonesian people themselves to the maximum to meet national energy needs. Whereas the energy crisis is threatening the country Indonesia and the world given the amount of energy such as petroleum, coal and other fossil energy materials are limited in number and impact resulting from energy use can damage the environment.

Based on data and facts, that have been presented in the previous discussion, it was obvious that geothermal energy is an alternative energy solutions to reduce emissions in the country of Indonesia. This is reinforced by the Indonesian government's policies related to CO_2 emission reductions, including:

1. Government commitment for reducing CO_2 emision up to 26 % in 2020
2. Government policy for electricity generation crash program (phase II) of 10.000 MW where geothermal energy contributes about 48% (4.733 MW)

Conclusion and Discussion

Geothermal energy has advantages compared with other types of energy, namely renewable, clean, and sustainable. From these advantages, geothermal energy can be a solution to reduce emissions of the world, especially in Indonesia. Indonesia is committed to reducing emissions by 26% in 2020, is one of them by developing geothermal energy for energy demand in Indonesia.

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Keterangan Penulis

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