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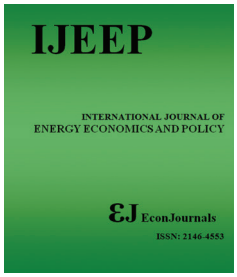

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The Analysis of Renewable Energy Management to Generate Electricity in Lampung Province Indonesia

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ABSTRACT

Electricity installed in Lampung is still a power plant with fossil fuels such as steam power plants, diesel power plants, gas engine power plants, and gas power plants. For this reason, it is necessary to make a revolution in the use of fuel in Indonesia, especially in Lampung, by reducing the use of fossil fuels and increasing the use of new fuels or renewable energy. Renewable energy sources are energy sources that are produced from sustainable energy resources if managed properly, including geothermal, wind, bio-energy, sunlight, water flows, and falls, as well as movement and differences in sea layer temperature. Lampung Province itself has a lot of potential renewable energy. With the existing potential, to preserve the environment, it is necessary to increase electricity production using renewable energy. The minimum addition from the current one is 50% for fossil energy and 50% for renewable energy. However, the existing obstacles need to be resolved with the support of the Government and the general public. So that in the future electricity production can increasingly focus on the use of renewable energy.

Keywords: Energy Management, Renewable Energy, Electricity
JEL Classifications: Q2, Q40, Q42

1. INTRODUCTION

The use of fuel is the main ingredient in creating energy, including creating electrical energy. The existence of a power plant with various resources used is an option for the State Electricity Company (PLN) in Indonesia in making its power plants. As of 2019, 52% of the types of power plants in Indonesia are still PLTU (Steam Power Plant). The remaining 48% just use other energy such as water, geothermal, and so on. The comparison can be seen in the following Table 1.

PLTU (Steam Power Plant) uses fuel in the form of coal which is a type of fossil fuel. Apart from coal, oil and natural gas are also included in fossil fuels. The use of fossil fuels has an adverse effect such as a change in energy from one form to another. These energy changes will usually affect the environment and air in various ways. Chemical energy contained in fossil fuels is transformed into mechanical energy, heat, or electricity through the combustion process and as the largest pollutant.

Thus, power plants, motor vehicles, and stoves are the main causes of air pollution. The pollutants released are usually classified into hydrocarbons (HC), nitrogen oxides (NOx), and carbon monoxide (CO). Pollutants produced in fossil combustion are the biggest factors in the occurrence of smoke, acid rain, global warming, and climate change.

Increasing the use of fuel, especially fossil fuels, absolutely will also increase carbon dioxide gas (CO_2) as a gas from the combustion of fossil fuels. As it is known that CO_2 gas is a component of greenhouse gases, it is estimated that every year around 18.35 billion tons of CO_2 are released. As the atmosphere gets richer in these greenhouse gases, it becomes an insulator that keeps more heat from the sun emitted to the earth, causing global

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Table 1: Installed capacity of PLN Indonesia basedon the types of power plants (MW)

Types of Power Plant	Installed Capacity of PLN Indonesia Basedon the Types of Power Plants (MW)		
	2019	2018	2017
Water Power	5,690	5,436	4,853
Steam Power	34,814	32,226	29,129
Gas Power	5,639	5,467	3,674
Steam Gas Power	11,525	11,249	11,597
Geothermal Power	1,986	1,986	1,503
Diesel Power	4,878	6,384	6,919
Gas Engine Power	1,745	886	299
Micro-Hydro Power	170	152	137
Solar Power	18	14	11
Other Power	143	146	265
Total Installed Capacity	66,608	63,947	58,387

Source: BPS (2019)

Table 2: Installed capacity PLN Lampung based on the types of power plants (MW)

Types of Power Plant	Installed Capacity of PLN Indonesia Based on the Types of Power Plants (MW) 2020		
	PLN	RENT/IPP/EXCESS	Total
Water Power	118.3	56	174.3
Steam Power	430	44	474
Gas Power	18		18
Steam Gas Power			0
Geothermal Power	100	110	210
Diesel Power	44		44
Gas Engine Power		148.9	148.9
Micro-Hydro Power			0
Solar Power			0
Biomass Power		3	3
Total Installed Capacity	710.3	361.9	1072.2

Source: Data of PLN Lampung Distribution

warming. The main cause of global warming is the burning of fossil fuels such as petroleum, natural gas, and coal which release CO_2 and other gases known as greenhouse gases into the atmosphere. Global warming has become an international issue and has become a world problem because its impacts can endanger living things in the world, including increasing earth temperature, climate change, rising sea levels, ecological disturbances, and the socio-political, impact (Sulistyono. 2012).

After seeing the condition of fossil fuel use in Indonesia, what about Lampung Province, the following is the data on the installed capacity of PLN Lampung according to the type of power plant (Table 2).

Based on these data, it can be seen that around 63% of the electricity installed in Lampung is still a power plant with fossil fuels such as steam power plants, diesel power plants, gas engine power plants, and gas power plants. Even according to Barusman and Redaputri (2018), the growth of electricity demand in Lampung Province is quite high, about 15% every year. Electricity ratio in Lampung only reaches about 76% so that electricity development is still needed to increase the supply of electricity, power quality and reliability. At the end of 2015, Lampung experienced the worst power deficit, which reached 79.4-189.3 MW in November. Therefore, it is necessary to do research to find out these criteria and alternative solutions for power distribution decision making management, to determine possible alternative decision-making fulfillment of electricity needs based on existing criteria and prioritize alternative decisions about what to do to fulfill electricity power in Lampung Province. For this reason, it is necessary to make a revolution in the use of fuel in Indonesia, especially in Lampung, by reducing the use of fossil fuels and increasing the use of new fuels or renewable energy.

Why should be renewable energy? Renewable energy must be developed nationally since if it remains dependent on fossil energy, this will pose at least three serious threats, such as the depletion of known petroleum reserves (without the discovery of new oil wells), price increases/instability due to higher demand rates from oil production, and greenhouse gas pollution (especially CO_2) due to burning fossil fuels. CO_2 levels are now said to be the highest for the past 125,000 years. If scientists are still debating the number of oil reserves that can still be explored, the bad effect of CO_2 on global warming has been agreed upon by almost all groups. This poses a serious threat to the lives of living things on earth. It is fairly settled in the literature that energy poverty can only be overcome by a sustainable energy development. For a sustainable energy development to be achieved there needs to be an efficient, reliable and decentralized energy system in the economy which is based on a clean energy source (Emodi and Bao, 2015).

Therefore, the development and implementation of environmentally friendly renewable fuels need serious attention. Renewable energy sources are energy sources that are produced from sustainable energy resources if managed properly, including geothermal, wind, bio-energy, sunlight, water flows, and falls, as well as movement and differences in sea layer temperature.

2. METHODOLOGY

This research uses a qualitative descriptive approach. Descriptive research is research that seeks to address existing problem solutions based on data. Descriptive research guides researchers to explore and or take pictures of social situations that will be studied in a comprehensive, broad, and in-depth manner (Sugiyono, 2014). Qualitative methodology is a research procedure that produces descriptive data in the form of written or spoken words of people and observed behavior. In addition, qualitative research is research that intends to understand the phenomena experienced by research subjects holistically, and by utilizing descriptions in the form of words and language, in a special natural context, and by utilizing various scientific methods (Moleong, 2007). So the purpose of this qualitative descriptive study is to describe the phenomena experienced by research subjects at this time in a holistic manner. In this research there is an attempt to describe, record, analyze and interpret the conditions that currently occur or exist (Barusman and Redaputri, 2018). In other words, this qualitative descriptive study aims to obtain information about the existing situation. The data used in this study are secondary data based on data held by PT. PLN Lampung Distribution.

3. DATA ANALYSES

General Conditions and Achievements in the Various New Energy and Renewable Energy Fields under Law Number 30 of 2007 concerning Energy, which is categorized as a new energy source is a source of energy that can be produced by new technology, both from renewable energy sources and non-renewable energy sources, including nuclear, hydrogen, coal bed methane, liquified coal, and gasified coal. Meanwhile, renewable energy sources are energy sources that are produced from sustainable energy resources if managed properly, including geothermal, wind, bio-energy, sunlight, water flows and falls, as well as movements and differences in ocean temperature. So that the management of various new and renewable energy fields is as follows: Energy Flow and Water Flow. The role of hydropower in the primary energy mix of power plants in 2013 was around 7.7%, wherein that year the total installed capacity reached 8109 MW.

As the name implies, new and renewable energy can always be used without worrying that the supply will run out. Alternative energy sources are also known to be environmentally friendly because they do not produce waste that damages the environment, in contrast to fossil fuels or petroleum which produces carbon dioxide gas and various other dangerous substances. In addition, new and renewable energy can be obtained free of charge, Sunlight, for example. Does the government collect taxes on the sunshine we use? Or does the government should pay the current of water that drives a power generator? The answer is absolute 'NO'. We just need to buy the equipment. Once we have electricity generation, we no longer have to pay for the energy we consume. It can be said, renewable energy power plants are a useful investment for life.

Even though new and renewable energies have several advantages, they also have drawbacks that make it necessary for people to consider carefully before making the switch. First, the initial installation costs are quite high. Currently, the power plant from alternative energy is still relatively expensive, for example, solar panels. This energy is also difficult to store and send widely because of its high price. In addition, renewable energy is also very reliant on natural factors that cannot be predicted or regulated. For example, in the event of a long drought, hydroelectric power plants will find it difficult to generate electricity because the water currents are not as fast as usual. It also happens to solar energy. When the weather is cloudy, you may not get enough light. Because this energy is still relatively new and has not been widely used, the supporting technology is also immature. Researchers are still trying to create technology that is cheaper and more efficient so that it can be used by many people.

To encourage greater use of renewable energy while reducing the use of fossil energy sources, the government through the Directorate General of New, Renewable Energy and Energy Conservation (EBTKE) has launched the following five steps:

(1) Increasing supply capacity for energy production. In the next few years, hydroelectric power (PLTA) and geothermal power plants (PLTP) will be intensified.
(2) Increasing the provision of access to modern energy for isolated areas, particularly in rural energy development using micro-hydro, solar power, biomass, and biogas.
(3) Reducing the cost of fuel subsidies, where the substitution of PLTD (Diesel Power Plants) with EBT generators can reduce subsidies.
(4) Reducing greenhouse gas emissions
(5) Massive energy savings.

To accelerate the achievement of water energy utilization rates and create a conducive investment climate by encouraging private participation, the Directorate General of New and Renewable Energy and Energy Conservation needs to improve policies that can regulate the price of electricity from hydroelectric power, encourage increased use of water energy as electricity generation. through a price scheme that attracts investors and funding institutions, specifically positions the role of the Government in regulating the use of water energy, and can filter out business entities that have sufficient capacity to develop Micro-Hydro Power Plants (PLTMH). As of 2014, the Directorate General of EBTKE has built 33 PLTMH units in several provinces in Indonesia with a total capacity of 2,225.39 kW.

The development of PLTMH through the APBN of the Directorate General of EBTKE is prioritized for regions that do not yet have access to electricity from PLN. Of the 33 PLTMH units, the number of households electrified is 5,511 households. B. Solar Energy Development of Solar Energy Utilization up to 2013 with a capacity of 67 MW, which includes PLN-owned plants in the form of 129 units of Solar Power Plants (PLTS) with a capacity of 25 MW, as well as 787 units built by the Government consisting of 5 PLTS units Interconnection, Centralized PLTS and Solar Home System (SHS) with a total capacity of 42 MW to meet electricity for communities in rural areas, outer islands, and border areas. To accelerate the achievement of solar energy utilization rates and create a conducive investment climate by encouraging private participation, regulations have been stipulated governing the purchase of electricity by PT. PLN (Persero) from the Photovoltaic Solar Power Plant based on the capacity quota offer through the Minister of Energy and Mineral Resources Regulation No. 17 of 2013. The highest benchmark price is set at 25 cents USD/kWh and 30 cents USD/kWh if using a PV module with a TKDN of at least 40%.

The bid price in the auction is used in the power purchase agreement, where the purchase price is valid for 20 years and can be extended. It is planned that the quota of PLTS that will be auctioned is around 140 MWp, which is spread over 80 locations in various provinces in Indonesia. To welcome this policy, as a pilot for the Interconnection PLTS business, the Ministry of Energy and Mineral Resources has built 5 units of PLTS Interconnection in Karang Asem, Bangli, Sumbawa. Bangka and Pangkajene Islands each with a capacity of 1 MW.

Wind Power Development until 2013 with a capacity of 1.3 MW, which includes:

- 1.2 MW interconnected with the PLN network (on-grid) and
- 0.1 MW off-grid. The utilization of small-scale water energy, solar energy, and wind energy is generally prioritized for the acceleration of electrification in rural areas, underdeveloped areas, and border areas/outer islands.

In the framework of implementing the Presidential Directive as outlined in the Presidential Decree No. 65/2011 concerning the Acceleration of Development in Papua and West Papua, the Provinces of Papua and West Papua are priority targets in energy infrastructure development activities by the Directorate General of New, Renewable Energy, and Energy Conservation as follows:

- In 2012, 225 kW in 8 districts with funds of Rp 37,268,051,453,
- In 2013, 1,711 kW in 10 districts with funds of Rp. 177,079,233,117,
- In 2014, 352 kW in 11 districts with funds of Rp 52,240,378,976, and the allocation of the Special Allocation Fund (DAK)

The Rural Energy sector, which is scattered in several districts for the Papua and West Papua regions, is:

- In 2012, spread over 25 districts received Rp. 158,648,670,000, - or 83% of the total budget of Rp. 190,640,000,000,
- In 2013, spread over 18 districts received Rp. 191,886,010,000, - or 44% of the total budget of Rp. 432,886,010,000,
- In 2014, spread over 22 districts received Rp. 238,622,160, - or 51% of the total budget of Rp. 467,940,000,

For the 2015 program, the Directorate General of EBTKE has proposed the availability of a budget for the construction of PLTM Oksibil with a capacity of 1 MW and PLTM Wabudori with a capacity of 3 MW through a multi-year mechanism based on the proposal of the Regent of Gunung Bintang and Regent Supiori. Related to the Domestic Component Level (TKDN) in PLTS, TKDN is between 40% - 43%, where the local production capacity can reach 110 MW per year. Whereas for PLTMH equipment, TKDN in civil works has reached 100%, but for mechanical electrical equipment it has reached 80% - 90%.

Based on these data in Table 3, it can be seen that around 63% of the electricity installed in Lampung is still a power plant with fossil fuels such as steam power plants, diesel power plants, gas engine power plants, and gas power plants. Meanwhile, 37% of them already use new and renewable energy, such as hydropower and biomass. This is in accordance with what Faizah and Husaeni. (2018) stated, energy consumption in all sectors in Indonesia, namely the industrial sector, household sector, transportation sector, commercial sector and other sectors tend to increase from year to year. Meanwhile, overall energy supply tends to increase, but with a smaller increase than the increase in consumption. And to overcome energy problem in Indonesia is needed energy conservation that is by conducting energy saving campaign, determination of energy conservation law, and establishment of energy conservation center. Next, the Indonesian government should have a long-term plan to divert the use of energy from non-renewable sources to renewable energy use, such as the use of water, wind, biomass, biodiesel, biogas and other sustainable energy sources.

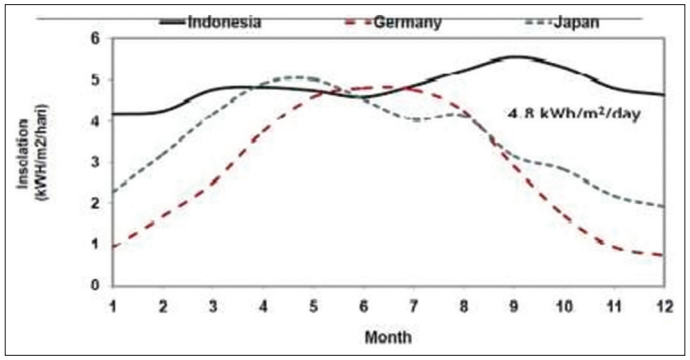
3.1. Solar Energy

Solar energy is potential energy developed in Indonesia, especially Lampung, considering that Indonesia is a country located on the equator with average energy that can be generated is 4.8 kWh/m^2/day. The intensity of solar radiation tends to be stable every month as shown in Figure 1. Therefore, solar energy has

Table 3: The current types of power plants

Types of power plants	PLN	SEWA/IPP/EXCESS	Total
Water Power	118.3	56	174.3
Steam Power	430	44	474
Gas Power	18		18
Steam Gas Power			0
Geothermal Power	100	110	210
Diesel Power	44		44
Gas Engine Power		148.9	148.9
Micro-Hydro Power			0
Solar Power			0
Biomass Power		3	3

Figure 1: Radiation Distribution Graph in Indonesia (Widayana, 2012).



advantages compared to fossil energy, including energy sources that are easily available, environmentally friendly, suitable for various geographical conditions, installation, operation, and easy maintenance. Electricity from solar energy can be stored in batteries. Solar cells or photovoltaic, abbreviated as PV, are equipment used to convert solar energy into electrical energy. PV has an efficiency ranging from 6% to 20% (Dubey et al. 2013). Solar power plants are very suitable for meeting remote areas that are difficult to reach by the PLN network with little need. With 100 Wp PV which has a length of 1.085 m and a width of 0.65 m, then for a certain area, the desired electrical energy will be obtained. Apart from generating electricity, solar energy can be used for drying.

3.2. Ocean Energy

Ocean energy is the newest energy alternative and includes non-living resources that have great potential to be developed in Indonesia. Apart from being a source of food, the sea also contains various energy resources whose role will be increasingly significant in anticipating a reduced supply of conventional energy. It is estimated that the potential for marine energy can meet 4 times the world's electricity demand so that various developed countries have developed it well in both research and commercial scales. The movement of waves in the sea can span hundreds of kilometers with only a slight reduction in energy. The technology of utilizing and converting energy into electrical energy using various types of turbines, such as axial turbines, piston turbines, and others. The area of Lampung includes the potential to be converted into electrical energy which is an extension of the western waters of Bengkulu with a minimum capacity of 30753.68 W and a maximum of 1968235 W.

3.3. Water Energy

The potential for hydro and micro hydropower plants spread throughout Indonesia with a total estimated total of 75,000 MW. However, only about 9% of the potential is exploited in the form of large-scale power plants and small-scale power plants. Especially on a small scale, the application of micro-hydropower plants in Indonesia began in 2005 at 0.45 MW. In 2006 and 2007, it increased to 0.69 MW. One of the strategies of the Indonesian government to use renewable energy is to increase the capacity to 20 MW from hydroelectric power in Eastern Indonesia and also from mini-hydro power plants, 21 MW in Java-Bali, 11 MW in Sumatra, and 18 MW for eastern Indonesia. Some of the construction of a 13.9 MW hydroelectric power plant in the eastern part of Indonesia, namely Siteba 3 × 2.5 MW, Buttono Pao 2 MW, Taludaa 3 MW, Segara 1 MW and 0.4 MW Lokomboro micro-hydro, while in Lampung province it is new. In 2018 the installation began and the installed capacity was 56.0 Mw. Planning for the development of electric energy from hydropower in Lampung, which starts from a capacity of 56 MW in 2018 and is planned to be 83 MW in 2025.

3.4. Wind Energy

The process of utilizing wind energy is carried out in two stages of energy conversion, namely: the wind flow will move the rotor (propeller) which causes the rotor to rotate by the blowing wind, then the rotation of the rotor is connected to the generator. From this generator, an electric current is generated. So the process of energy conversion steps starts from wind kinetic energy into rotor motion energy then becomes electrical energy. The amount of electrical energy produced is influenced by several factors, including the following:

The rotor (pinwheel), the type of turbine rotor is very varied, the diameter of the rotor is directly proportional to the electric power. The larger the diameter, the greater the electricity generated, seen from the number of rotors (propeller) angles, angles with a small amount ranging from 3 to 6 pieces are more widely used. Wind speed, wind speed will affect the rotational speed of the rotor which will drive the generator.

Types of generators, generators are divided into several different characteristics, generators suitable for the Wind Energy Conversion System (SKEA) are generators that can generate electric current at low speed.

The potential for wind power plants in Lampung is a group that is less potent than other regions in Indonesia and is marginal (., 2016). The following is a table of wind power potential in Indonesia.

The electricity generated from the Wind Energy Conversion System will work optimally during the day where the wind blows quite fast compared to at night, while electricity usage will usually increase at night. To anticipate this, this system should not be used directly for electronic products, but first stored in one medium such as a battery or battery so that the amount of electricity that comes out is stable and can be used at any time. In developing the wind energy generator, Lampung province is planned to build a power plant in 2022 with a capacity of 5.9 MW.

3.5. Biomass Energy

Plantation and agriculture are a very developed business sector in Indonesia, this shows a high enough potential to meet the source of raw materials for making biomass. According to DITJEM EBTKE, the Ministry of Energy and Mineral Resources in 2013, has mapped the potential for producing biomass from various sectors in Indonesia, from this map it can be seen which areas have the highest potential, so that they can be used as a location for more efficient biomass energy production. Lampung is an area that has the potential to produce biomass energy. One of the biomass energy potentials is from oil palm plantations with a production of 166,217.61 tonnes/year. In addition to biodiesel produced from palm oil products, electrical energy can be generated from biomass waste such as palm kernel shells and empty palm fruit bunches.

3.6. Geothermal Energy

The geothermal energy potential of Lampung is located in the Ulubelu area, the Ulubelu geothermal area is located in the villages of Pagar Alam and Muaradua, about 45 km from the Talangpadang district or about 125 km from the city of Bandar Lampung. The power plant started operating in 2012 and is operated by two companies PLN and PGE. Currently, the total electricity produced is 165 MW by PLN while steam is produced by PGE. The steam temperature produced is an average of 265°C with an average enthalpy of 1160 kJ/kg The Ulubelu geothermal power plant consists of three units, Ulubelu unit-1, unit 2, and unit 3. In 2017, unit 4 Ulubelu plans to operate with 55 MW.

Mount Rajabasa or known by another name, Mount Rajobaso is one of the Stratovolcanoes in Indonesia with a classification of type B. Mount Rajabasa is located in the Penengah and Kalianda districts, South Lampung Regency, Lampung Province, with the peak geographical position at 05o47'00 "LS and 105o37. '05 "BT. Mount Rajabasa has two peaks, namely the peak of Mount Balerang and the peak of Rajabasa with an altitude of 1281 m above sea level (Rajabasa) and 1181 (Balerang), besides that it has four craters namely peak craters, the existence of craters as a geothermal manifestation is one of the important parameters of geothermal potential in the area the. Based on regional geological data, Mount Rajabasa is located at the intersection of the fault with the northwest-southeast and northeast-southwest directions). The two regional faults are interpreted as hydrothermal flow pathways to the surface. On Mount Rajabasa, it is planned to build a generator with a capacity of 91 MW (Pambudi, 2018).

However, this renewable energy potential cannot be utilized properly, due to several constraints such as technology, funding, and availability of raw materials. The technology that is available and applied for the use of renewable energy is not yet very advanced, this is related to a large amount of funding. Meanwhile, the budget available by the State may not be sufficient. In addition, the availability of raw materials is available but is constrained by permits and the local community.

4. CONCLUSIONS

Currently, the use of fuel in Indonesia in general and Lampung in particular, renewable energy to generate electricity is still low compared to fossil fuels. As much as 63% of the electricity installed in Lampung is still a fossil fuel power plant such as steam power plants, diesel power plants, gas engine power plants, and gas power plants. Meanwhile, 37% of them already use new and renewable energy, such as hydropower and biomass, they still need to be added. Even though the potential for renewable energy in Lampung Province is still very large, including solar energy, marine energy, water energy, wind energy, biomass energy, and geothermal energy. This occurs because there are obstacles in terms of technology, funding, and availability of raw materials.

With the existing potential, to preserve the environment, it is necessary to increase electricity production using renewable energy. The minimum addition from the current one is 50% for fossil energy and 50% for renewable energy. However, the existing obstacles need to be resolved with the support of the Government and the general public. So that in the future electricity production can increasingly focus on the use of renewable energy. According to mustikaningsih (2019), to improve business performance, strategic partnerships need to be carried out optimally through various efforts including strengthening collaboration in aligning the supply chain and developing dynamic capabilities within the organization. For the future, it is expected that all stakeholders involved in the renewable electricity generation industry in Indonesia can improve their business performance so that they can increase electricity supply to remote villages and able to transform use of primary energy sources from fossils to environmentally friendly renewable energy where potential is widely spread throughout region so that sustainable life in the world is more awake.

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