



# Renewable Energy and Human Resource Development: Challenges and Opportunities in Indonesia

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Received: 28 September 2019

Accepted: 02 January 2020

DOI: <https://doi.org/10.32479/ijeeep.8782>

## ABSTRACT

The availability of renewable energy and quality human resources is expected to be a major factor to bring Indonesia to reach glory in 2045. Therefore, this paper aims to investigate and explore the challenges and opportunities for renewable energy and human resource development in Indonesia. This paper uses conceptual and systematic review analysis to highlight the special issue of renewable energy and human resource development. This paper reveals that renewable energy and human resource development become a great foundation of Indonesia needs in the future.

**Keywords:** Renewable Energy, Energy Consumption, Human Resource Development, Indonesia

**JEL Classifications:** Q20, Q28, O15

## 1. INTRODUCTION

Indonesia is indeed a very broad country which has abundant natural and energy resources, both in the soil and at the surface. Indonesia has enormous potential to develop renewable energy such as solar, wind, water, and waste. However, the use of renewable energy in Indonesia is still very low. It is necessary to increase studies relating to all types of renewable energy resources as a whole (Desfiandi et al., 2019; Hidayatno et al., 2019; Mustikaningsih et al., 2019; Putrasari et al., 2016; Setiartiti, 2018; Sharvini et al., 2018).

The renewable energy mix target of 23% by 2025 might be a big challenge for Indonesia. Not only that, this target will continue to increase to 31% by 2025. However, until 2016, Indonesia has only reached 6.51% of renewable energy production. Energy demand will certainly increase and it is predicted that the national final energy demand will reach 238.8 million MTOE until 2025 or 1.8 times the final energy consumption in 2015.

Although Indonesia's geographical conditions have the potential for renewable energy development, the transition to energy is still a major challenge. The gas sector will continue to develop as an

alternative renewable energy source. This is because the price is more affordable compared to other renewable energy sources. Besides, Indonesia also still has enough gas reserves so that it will become the foundation of national needs in the future (Maulidia et al., 2019; Sinha and Sengupta, 2019).

The development of new and renewable energy in various regions in Indonesia is not only related to infrastructure development issues but also must be balanced with increased human resource capacity in the area. The human resource factor is indeed very important, given a large number of development of new and renewable energy sources carried out in remote areas, but rarely found qualified human resources (Hilmawan and Clark, 2019; Yang et al., 2019). Therefore, PT Perusahaan Gas Negara Tbk (PGN) collaborates with several well-known universities in Indonesia to develop human resources so that they contribute positively to the achievement of national goals.

## 2. METHODOLOGY

This study uses conceptual and systematic review analysis. Academic search premier and business source premier are searched

for the year 2005-2019 using terms “renewable energy” and “human resource development.” 26 articles fit the review criteria in the synthesis of the proposed topic to highlight renewable energy and human resource development (Table 1).

### 3. RESULTS AND DISCUSSION

According to data from the International Renewable Energy Agency, Indonesia has the potential to produce 716 GW of energy from solar photovoltaic, hydropower, bioenergy, geothermal, ocean wave power and wind. However, Indonesia still faces challenges for the development of renewable energy, ranging from the limited open land for the utilization of energy from solar photovoltaic to the high investment costs for the utilization of new and renewable technologies.

#### 3.1. Depending on Fossil Fuels

The main barrier to the transition to renewable energy in Indonesia is a very high level of dependence on fossil fuels. Energy sources in Indonesia are currently still focused on fossil energy. Fossil energy reserves, which are only able to survive around the next

10-13 years, cannot bring Indonesia to its expected condition in 2045. Consumption of fuel oil (BBM) is still very high although domestic production continues to decline. Supply of all energy in Indonesia for the 2000-2015 is presented in Figures 1 and 2.

From 2017 to 2025, the supply of fuel can no longer meet domestic needs. As a developing country, Indonesia is still trapped in a long-term agreement on fossil fuels and economic architectural conditions. Some steps that can be taken to alleviate this problem are to create a dialogue between institutions that encourage the transition to renewable energy on a regional scale and conduct a feasibility study for cross-country renewable energy. Therefore, the transformation of fossil energy into clean and renewable energy will have a major impact on the expenditure of development funds from the state budget, networks to remote areas and the availability of sustainable energy sources.

#### 3.2. Imbalance and Inequity of Subsidies

Energy subsidies are a significant financial burden for the Indonesian government. In 2017, Indonesia has spent 77.3 trillion rupiahs on energy subsidies or 4.4% of state revenue. Subsidies provided by

**Table 1: Empirical support for identified propositions**

S. No.	Propositions	Empirical support from reviewed literature
1.	Energy and natural resources on human development	Energy and natural resources establish human development (Dias et al., 2006)
2.	Energy and natural resources on human development	Energy and natural resources increases human development and policies (Leal and Singh, 2012)
3.	Energy consumption and economic growth	There is a causal link between energy consumption and economic growth (Dritsaki and Dritsaki, 2014)
4.	Energy consumption and economic growth	Energy consumption stimulates economic growth (Naser, 2014)
5.	Energy consumption and economic growth	There is no causal relationship between energy consumption and economic growth (Osigwe and Arawomo, 2015)
6.	Energy consumption and economic growth	Energy consumption significantly affects economic growth (Awad and Yossof, 2016)
7.	Renewable energy consumption and economic development	Renewable energy consumption increases economic development (Zaman and Moemen, 2017)
8.	Renewable energy and economic development	Renewable energy determines economic development (Soukiazis et al., 2019)
9.	Energy consumption and economic growth	Energy consumption relates to economic growth (Khobai and Le Roux, 2017)
10.	Energy consumption and economic growth	There is any relationship between energy consumption and economic growth (Mahmoodi, 2017)
11.	Energy consumption and economic growth	Energy consumption does not cause economic growth (Burakov and Freidin, 2017)
12.	Energy consumption and economic growth	There is no interconnection between energy consumption and economic growth (Nuryartono and Rifai, 2017)
13.	Renewable energy consumption and human development index	Renewable energy consumption does not affect human development index (Wang, Danish, Zhang and Wang, 2018)
14.	Renewable energy and policy implementation	Renewable energy has a positive impact on policy implementation (Novianto et al., 2018)
15.	Energy consumption and human development	Energy consumption is linked to human development (Sharvini et al., 2018)
16.	Energy and human resources use	Energy increases human resources use (Day et al., 2018)
17.	Renewable energy and human development	Renewable energy promotes human development (Jakob, 2018)
18.	Natural resources and human development	Natural resources have a positive effect on human development (Sinha and Sengupta, 2019)
19.	Renewable energy consumption and economic growth	Renewable energy consumption decreases economic growth (Maji and Sulaiman, 2019)
21.	Energy consumption and economic growth	Energy consumption increases economic growth (Banday and Aneja, 2019)
22.	Renewable energy and human capital	Renewable energy affects human capital (Mahmood et al., 2019)
23.	Renewable energy and economic growth	Renewable energy stimulates economic growth (Zafar et al., 2019)
24.	Renewable energy and economic development	Renewable energy promotes economic development (Acharya and Sadath, 2019)
25.	Energy consumption and human capital	There is a significant relationship between energy consumption and human capital (Bashir et al., 2019)
26.	Energy consumption and economic growth	Energy consumption increases economic growth (Sriyana, 2019)

Figure 1: Supply of all energy in Indonesia (Pusdatin, 2016)

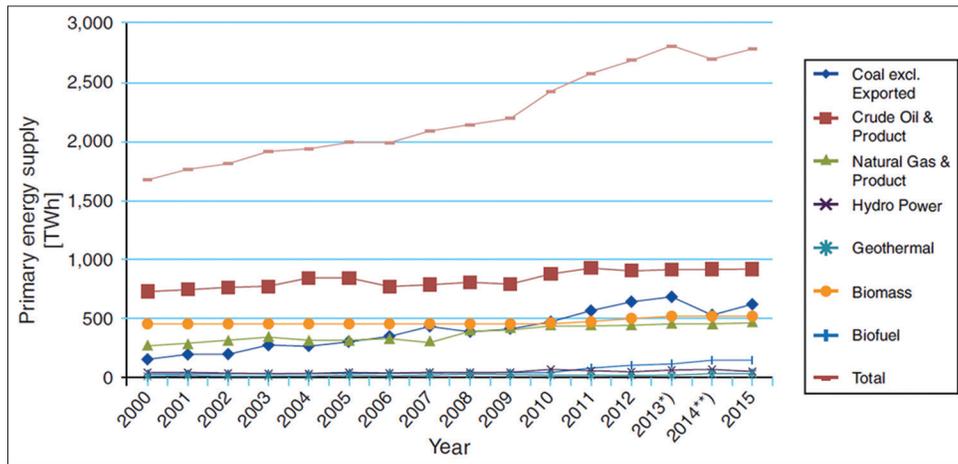
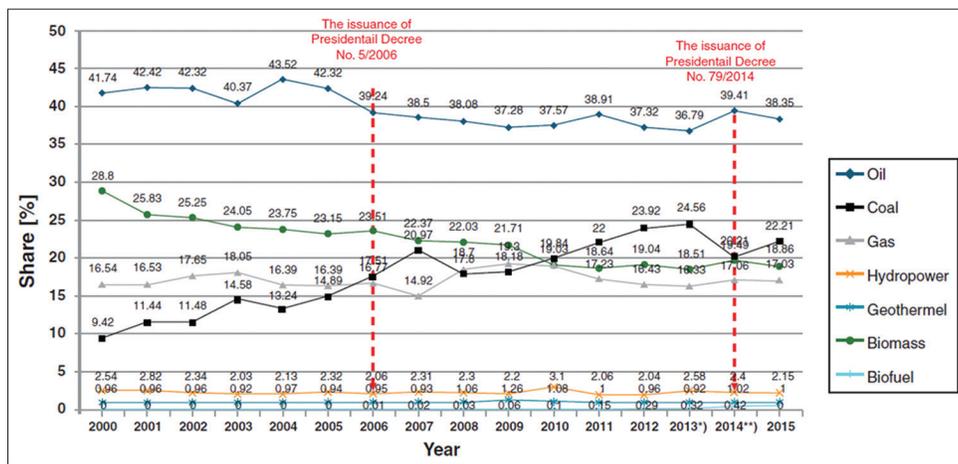


Figure 2: Supply of all energy in Indonesia (Pusdatin, 2016)



the government cause tariffs for fossil energy to be cheaper, making them easily accessible to the public. Renewable energy still has more expensive tariffs because technology investment costs are quite high. This makes it difficult for renewable energy to compete with fossil energy that is still subsidized.

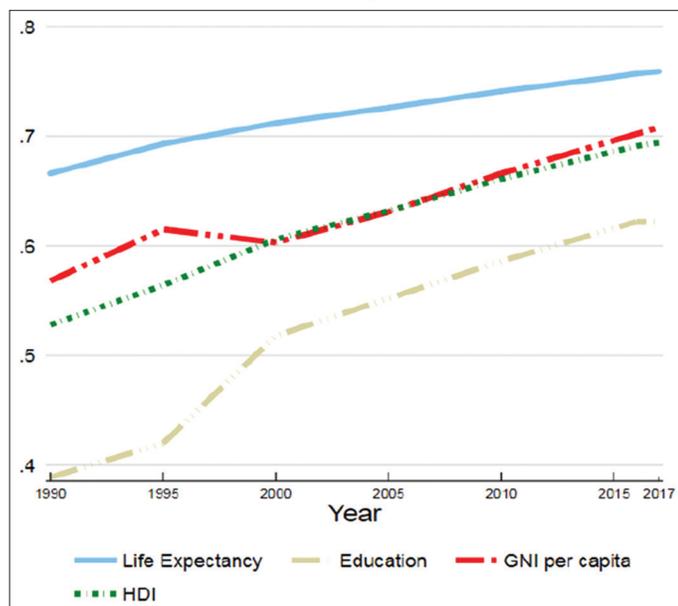
Based on ESDM Ministry data, around 12,659 villages in Indonesia have not yet fully enjoyed electricity. 65% of the villages are in eastern Indonesia. The government has established a feed-in tariff mechanism to encourage the use and installation of renewable energy systems. This mechanism requires major utility companies to pay for electricity tariffs generated from renewable energy sources, where these tariffs are a maximum of 85% above the production cost of production (BPP) from fossil fuels. However, there is no clear mechanism as to who will replace the additional costs incurred by PLN to buy electricity from renewable energy producers. If these costs are charged to the community, the costs for electricity from renewable energy will remain expensive and remain difficult to compete. It is better if the tariff given to electricity producers from renewable energy is set as high as possible to attract investors. PLN also needs to be guaranteed that the additional costs to be incurred will be borne by the government. Determination of tariffs to the community must also be adjusted to the condition of the ability of the community, where higher

electricity tariffs are given to larger users. This will encourage large-scale electricity users to use renewable energy from solar photovoltaic, thereby reducing electricity consumption from PLN.

### 3.3. Investment Limitations

In Indonesia, there is still very little investment in research and development of renewable technologies provided by the government. The availability of research materials, infrastructure, and research facilities is still very limited. Besides, only a few PLN staff have the capability of renewable energy to be implemented on a large scale. Another factor is that most of the renewable technology is still imported from abroad and very few industries support the development of renewable energy. This resulted in a very slow transition to renewable energy in Indonesia.

From 2011 to 2017, the Directorate General of New and Renewable Energy and Energy Conservation (EBTKE) of the Ministry of Energy and Mineral Resources (ESDM) has built 686 units of power plants worth 3.01 trillion rupiahs, which are scattered in various regions in Indonesia. Areas, in general, are isolated, and not yet reached by the electricity flow of PT PLN (Persero). The source of funding for these activities is from the state budget, and not private investment. Of this amount, there were 126 units of activities valued at 1044 trillion rupiahs that had not been submitted

**Figure 3:** Indonesia's HDI components indices 1990-2017

and received by the local government, and 68 other activities valued at 305 billion rupiahs suffered minor and severe damage.

All construction activities which have been subjected to the audit have been completed, but some of them have experienced damage in operation due to various reasons. The government has inventoried the activities of new and renewable energy plants that have been damaged, for immediate repairs.

In the 2017 fiscal year, the Ministry of Energy and Mineral Resources has gradually budgeted a repair fee of 8.9 billion rupiahs. However, these activities could not be carried out because there were no partners interested in carrying out repairs to new and renewable energy power plants, so the tender failed. In 2018, the Directorate General of EBTKE of the Ministry of Energy and Mineral Resources has budgeted the cost of repairs of 17.68 billion new and renewable energy whose implementation is being reviewed through self-management cooperation so that there will be no more auction failures. The larger repair budget is intended so that the repair of 68 units of new and renewable energy generating activities that are damaged can be completed completely so that the community can immediately optimize their utilization.

### 3.4. Lack of Coordination between Agencies

Poor coordination between ministries and agencies will cause the development plans that have been determined to be inconsistent. In Indonesia, there are 7 institutions responsible for renewable energy policies. Data differences between institutions can be different so that renewable energy development is not optimal. Besides, policies related to the development of renewable energy relatively change every time, for example in the determination of feed-in renewable energy tariffs. Indonesia's HDI components indices for 1990-2017 are shown in Figure 3.

The existence of regional autonomy is also a challenge for local governments to implement renewable energy development policies and programs. Sometimes local governments do not yet

have sufficient capacity to utilize renewable energy resources, moreover, research on renewable energy technologies in Indonesia is still small so human resource capabilities are still low. The government is expected to reaffirm its commitment to increase the 23% renewable energy mix and ensure the implementation is carried out consistent with the plans and visions that have been made. Without more appropriate policies or support, the transition to renewable energy may still be slow.

## 4. CONCLUSION

Based on the conceptual and systematic review analysis, this paper concludes that renewable energy and human resource development become the great foundation of Indonesia needs in the future. The ability of human resources to operate and maintain new and renewable energy facilities is considered to be very limited. This condition has become the concern of various institutions, both national and international. Therefore, Indonesia is always flying between building infrastructure and developing people to reach glory in the future.

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