AIMS Energy, 10(1): 23–44.
DOI: 10.3934/energy.2022002
Received: 13 November 2021
Revised: 14 January 2022
Accepted: 20 January 2022
Published: 27 January 2022

http://www.aimspress.com/journal/energy

Review

Policies and laws in the application of renewable energy Indonesia: A reviews

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Abstract: Renewable energy is a global energy system that is very important in nature and humans' harmonious and conducive development. Considerable attention from the government towards renewable energy is due to the increasing energy demand. The impact of the current energy shortage has also resulted in damage to the environment. The current legal framework for accelerating the development of renewable energy has made a considerable contribution but is still not in favor of investors. Thus, the integration of renewable energy into the national energy system is still far from being expected, so the cooperation between the government and industrial development must be further enhanced. The specific aim of this work is to adopt various practices and policies towards the development of renewable energy from several developing countries. A critical review of this work will discuss policies and legislation on renewable energy policies especially under-operation, fragmentation, and obsolescence. Policies in favor of renewable energy developers are also presented in this paper. This paper as a whole investigates various renewable energy development policies from developing countries to be adopted in ensuring the availability of energy security in the future.

Keywords: policy and law; achievements; renewable energy; improvement; development of RE

1. Introduction

Non-renewable natural resources and fossil fuels are depleting in recent years. In addition, the serious level of environmental pollution has given concern to the global community [1–3]. Alternative energy sources from renewable energy are one of the right choices to reduce environmental pollution, combat energy shortages, and encourage sustainable development economically and socially [4–6]. The continuity of the organization and the increase in industrialization in several countries have caused the need for energy to continue to increase [7–9]. Meanwhile, China's oil, coal and gas resources have a remaining duration of exploitation for less than 30 years. The overall availability of traditional natural resources is below the global average [10–12]. Based on these problems, the governments of several countries have decided to take steps to develop renewable energy [13–19].

The policy and legal system for renewable energy is a very important factor. In addition, the acceleration of the exploitation of renewable energy cannot be separated from the existence of better policies and laws. The significant increase in renewable energy is also shown in the Statistics of the National Energy Administration (NEA). Solar and wind power plants installed every year also continue to increase rapidly. Where the two energy plants are ranked first in recent years worldwide [20–22]. However, the policy and legal framework for renewable energy have limitations so that the sustainable development of renewable energy can be hampered. Therefore, the policy and legal system for renewable energy must be further improved so that the state of the existing renewable energy industry becomes more important practically and theoretically.

Global energy consumption in the last two years has experienced a significant increase. The increase in energy consumption worldwide is inseparable from the 2019 new coronavirus disease (COVID-19) pandemic. Energy consumption continues to increase also has an impact on increasing carbon emissions as reported by [23]. The impact of the 2019 coronavirus disease (COVID-19) pandemic has presented a huge challenge to the world's energy consumption. The United States is one of the countries experiencing the worst oil decline as reported in a study by [24]. The decline in oil in the US reached 973 trillion as of January 2020–March 2021, where US oil consumption was around 18.14%. While China is the first country to explore for economic recovery after the COVID-19 pandemic on the economic growth and energy consumption of other countries [25]. The economic growth of countries with upper middle income (0.17%) is very closely related to China's economic growth. China's energy consumption has the most significant impact on high-income countries (0.11%-0.45%).

The main focus of this work is to sort out the policy and legal framework for renewable energy development. To identify the disadvantages and advantages of implementing a system of policies and laws that are reviewed practically and comparatively from several countries. In addition, suggestions for implementing a policy and legal system for renewable energy so that it can be formed efficiently and systematically.

2. Law and policy framework for renewable energy

The utilization and development of renewable energy is the main goal in overcoming the shortage of fuel from agricultural sources as China did before 1990. The relevant basic guidelines are taken as the basis for policies in developing renewable energy in remote areas. Laws and policies on renewable energy, in particular, have been progressively released from 1990–2005. This is done to detect various air pollution other than energy in rural areas. The Renewable Energy Law (REL) is the most important

and has been in effect since 2005 and has been amended in 2009. There are also laws regarding protection laws related to renewable energy including the environment, climate, and energy. China is one of those countries that has developed a five-year plan, medium-term, and set guidelines in the long term to be able to promote renewable energy. In particular, the national plan designed by China has a major position contained in the renewable energy policy law. Even these laws and policies have been able to implement and produce a better effect among all the laws that were applied at that time. The policy and legal system for renewable energy have been established in China by taking the basis of REL. The law is also equipped with several other related policies as shown in Figure 1.

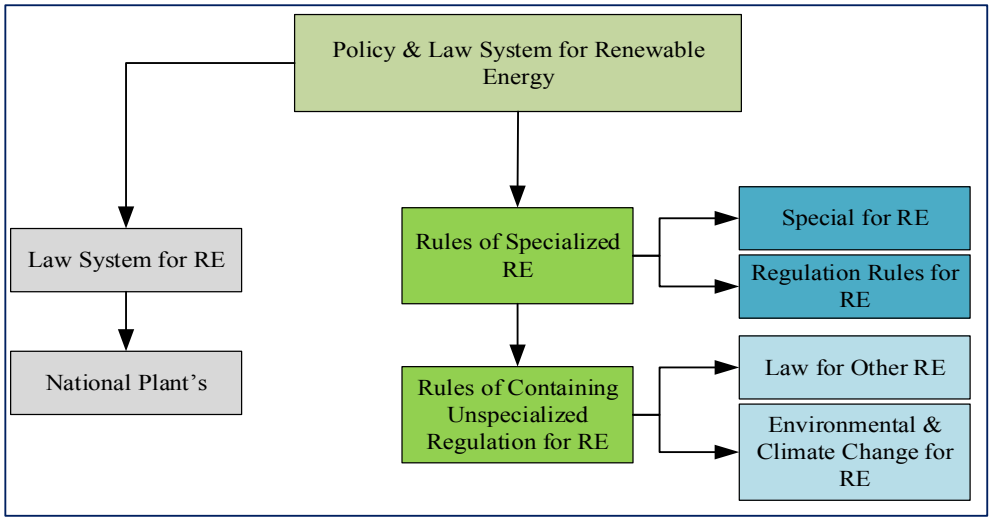


Figure 1. General Law and policy framework for renewable energy.

The system in the utilization and exploitation of renewable energy applied in China is based on the law applied to REL. This system has covered all aspects of comprehensive renewable energy development. A comprehensive investigation was carried out on development plans, resources, technical support, industry, popular applications, cost-sharing, price control, supervision, economics, and legal responsibilities [26,27]. Central ministries as well as local governments have implemented several joint regulations based on REL. The regulations have been stated in the central and regional joint regulatory documents. Renewable energy has specific rules as issued by different authorities at the central level. However, the implemented renewable energy law does not only depend on the government management system. Where the central government and local governments must both straighten and pass on to the bureaucracy throughout the country [28–30]. Meanwhile, the regions themselves also have special regulations on the use of renewable energy because it is a special autonomy. Thus, the exploitation and utilization of renewable energy can improve its economy without having to depend on the center.

Several laws other than the specific law on renewable energy will also involve this issue as shown in Figure 2. For example; there is one type of energy, then that energy is automatically included in the energy conservation law (ELC) so that the utilization and development of renewable energy get support. In addition, power generation through clean energy sources is supported by the electricity law. Meanwhile, renewable energy issues such as climate and environment can also be protected by this law. This is because renewable energy has a low carbon and cleaner properties so that pollutant

emissions can be reduced and the benefits to the environment are significantly greater [31–33]. The largest country in producing sulfur dioxide, particulates, greenhouse gas emissions, and nitrogen oxides is China compared to other countries. Where the emissions produced are sourced from primary energy consumption of 67% and coal-fired power plants reaching 73%. Thus, it will increase awareness in protecting the environment so that the exploitation and efficiency of renewable energy can be increased by the existence of clearer protection laws.

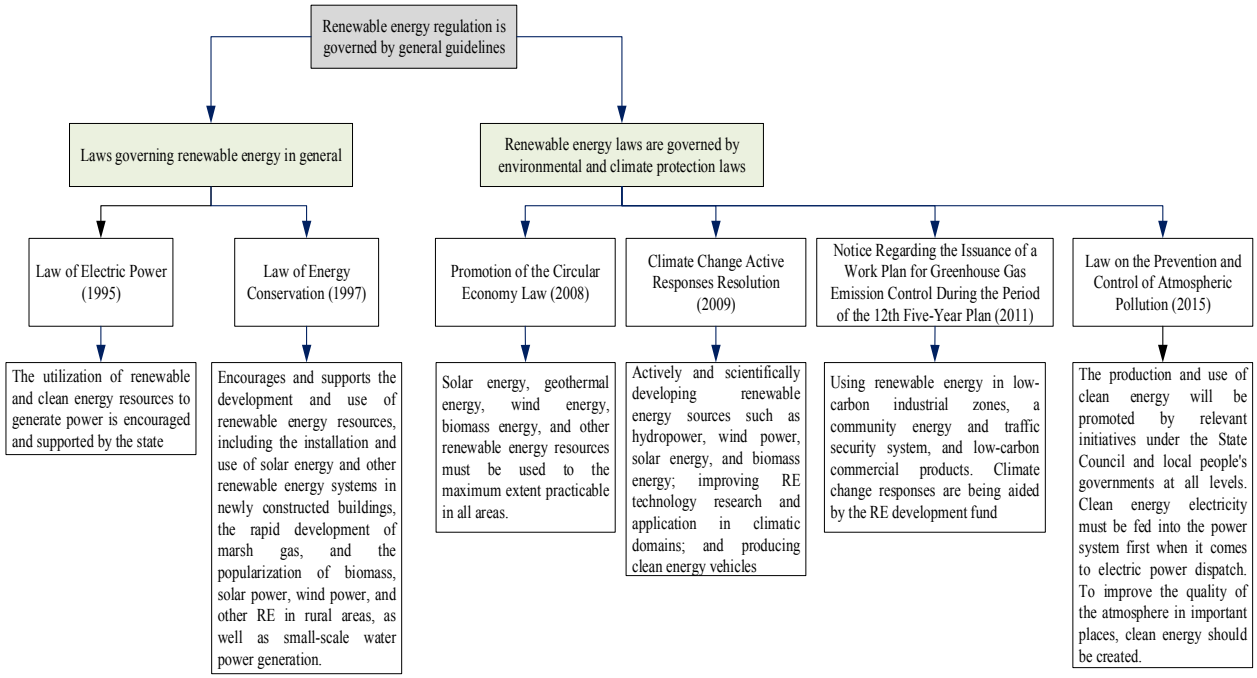


Figure 2. Renewable energy regulations are governed by non-specialized rules.

The policy has a very important role to promote renewable energy. In addition to law, economic and political issues also play a very large role in encouraging the development of renewable energy. Thus, a series of national plans must be formulated so that the objectives in the utilization and development of renewable energy have a precise strategy as presented in Table 1. This policy has been recognized for being able to solve problems quickly and flexibly. In this case, the effects of existing policies can provide faster and more profitable results than the law. Therefore, a higher position can be achieved when there is a national plan, especially a system of policies and laws. The establishment of basic guidelines and targets regularly has helped improve market mechanisms. In addition, the allocation of social resources can be optimized in mobilizing enthusiasm for renewable energy investment [34–36].

Table 1. Plans for renewable energy at the national level.

No.	Year	Plan and development	Energy Sources
1	1995	New energy and renewable energy development guidelines	RE situation, problems, future tasks, and favorable policies
2	2001	Plan for environmental preservation at the national level	Wind, solar, biomass, and other alternative energy technologies are being vigorously developed
3	2001	The tenth five-year strategy for the development of new energy and renewable energy businesses has been released	Goals, major objectives, strategies, and actions taken in the development of new energy and RE
4	2006	RE has a long-term national scientific and technical development plan	Making a breakthrough in energy-saving and clean-energy technologies; Prioritizing energy technology development; Recognizing energy as a critical pressing issue
5	2007	Agricultural biomass energy industry development plan	Increasing the pace of rural biogas construction by emphasizing the circular use of agricultural biomass energy.
6	2007	Plan for the development of renewable energy in the medium and long term	Highlighting the current state of renewable energy development and outlining the goals of significant renewable energy sources
7	2008	Renewable energy development's eleventh five-year plan	Situation, principles, objectives, critical fields, environmental impact, and incentive policies
8	2012	12^{th} renewable energy development five-year plan	During the 12^{th} five-year plan term, the major responsibilities of RE development will be established
9	2016	13^{th} renewable energy development five-year plan	During the 13^{th} five-year plan term, the major responsibilities of RE development will be established

The application of the legal system to renewable energy has provided a very large level of progress after development as practiced in China. Where gradually the policy and legal system for the disposal of renewable energy can be formed in stages and is more relative and complete. The law is complete because it has a REL basis so that the regulations in it are declared appropriate. These renewable energy laws and policies are under the guidance of the government in every use and development of renewable energy. Where the trend of renewable energy development that has not happened before can experience a significant increase.

3. Renewable energy achievements

The system of policies and laws on renewable energy centered on the REL of several developed countries has been able to develop on a large and fast scale. This is an extraordinary target and achievement that has been created with the presence of industrial technology and available installed capacity. The installed capacity of wind, solar, and hydropower plants each year increased by 34.6%, 7.1%, and 135.3%, respectively, during the period 2008–2017. The installed capacity for renewable energy generation at the end of 2017 in China reached 635 million kW. Whereas much as 35.7% of the installed capacity is intended for electricity from the total. The largest installed capacity is hydroelectric power plants which reach around 341 million kW or 19.2%. Meanwhile, the total installed capacity for wind power plants is 164 million kW or 9.2% and solar power plants can contribute 130 million kW or 7.3% of the total installed capacity [37–39]. In 2016 China's electricity consumption sourced from renewable

energy nationally reached 1506 wild kW or 25.3% of the overall consumption with an increase of 0.9% from year to year [40].

The maturity of the application of renewable energy technology has gradually improved especially for solar and wind energy sources. Power generation technology with renewable energy sources from wind shows the lowest in recent decades. However, the consumption of technology based on micro-grids and wind power has made enormous progress. In addition, energy storage technology has been gradually improving and developing. The main exporter and producer of technology from renewable energy sources, the largest currently reported in China. China's solar panels account for about two-thirds of global solar panels and half of the world's turbine generators are in China [41–43]. The construction of a high-arched concrete dam is used for hydroelectric power generation. Where the height of the concrete reaches approximately 300 m which is carried out in China. However, there are some very large gaps from other countries regarding key technology development and innovation capabilities. Thus, this problem becomes one of the main obstacles in carrying out the rapid development of renewable energy sources, especially in China. Meanwhile, in Indonesia, the total installed capacity of power plants from renewable energy sources has only reached 10,467 MW in 2020 [44]. Renewable energy generation capacity in Indonesia is dominated by hydroelectric power plants (PLTA) of 6.121 MW, geothermal power plants (PLTP) 2.130.7 MW, bioenergy plants 1.903.5 MW, wind power plants 154.3 MW, solar plants 153.5 MW, 3.6 MW hybrid generator.

The relationship between renewable energy consumption and economic growth was investigated from new risk-based viewpoints, including political risks, financial risks, economic risks, and composite hazards [45]. When composite hazards and political risks are employed as threshold variables, the results reveal that renewable energy usage and economic development have a single threshold. Economic growth has a linear relationship with renewable energy, so the relationship between the two cannot be ignored [46–48]. The nonlinear relationship between economic growth and renewable energy especially in OECD countries was investigated by developing a threshold panel regression model. The development of renewable energy has a short-term impact on free trade [49]. Meanwhile, in the long term, free trade in the development of renewable energy is still very wide open.

4. Other countries' renewable energy programs and laws

The development of renewable energy technology that is very smooth and safe cannot be separated from the guarantee and support of policies and laws as described in several developed countries including the following:

The establishment of a policy and legal system for renewable energy and the economy is one of the most important. The Australian government is fully aware that a complete system of policies and laws on renewable energy can function and power externally for renewable energy development. The Australian Government has announced and mandated related to the Renewable Energy Target (RET) in 2001. Where the announcement is the first globally to set the goal of developing renewable energy by pouring it into law. In 2009 the RET was extended to ensure that as much as 45,000 GW of electricity is sourced from renewable energy. Where electricity sourced from renewable energy reaches 20% which covers Australia's total electricity consumption by 2020 [50–52]. The Law on Electricity and Electricity Costs from renewable energy sources has recently been formulated so that the stated objectives can be achieved. The energy laws based on the comprehensive RET have been specifically enacted. Where the Australian government has implemented a broad policy of incentives for financial subsidies, credit

loans, and tax breaks for all sectors, especially those using renewable energy. Where the policy is felt to be very effective for the transportation industry which requires a lot of energy. The Australian government provides a maximum subsidy of 20 thousand dollars provided for infrastructure and operating facilities. The subsidy of 20 thousand dollars is given to the supply of the fuel sourced from a mixture of E10 ethanol. Meanwhile, the federal consumption tax subsidy has been reduced by USD 0.38/liter of ethanol [53–55].

Furthermore, the launch of reforms carried out by the Australian government on the energy market aims to break the monopoly nature of the market in the energy sector so that energy can be ensured that it is stable and affordable for the people. In this way, the legislation developed by the Australian government specifically on the energy market can be stabilized. With such a principle, investment in the energy market will be more interested in increasing competition with the tax incentives offered can be taken and implemented. As determined in 2006 that the self-market mechanism contained in the National Energy Effectiveness Framework is the key to meeting strategic objectives in renewable energy development in Australia.

The most successful country in promoting renewable energy with a view to a sustainable energy transition today is Germany. Renewable energy in Germany has a historical development to adjust policies and laws promptly so that they can be more relevant which is a vital factor. The law for the transition of electric power was promulgated by the German government in early 1991 to promote the development of renewable energy. The purpose of the law is to be able to provide high standard subsidies and preferential loans in conducting and supplying electricity. The launch of liberalizing reforms to the electric power market in 1998 was aimed at providing incentives to the law on a sustainable basis. Where in 2000 the German government was able to pass a special law for the Renewable Energy Act (REA). This has proven that the law is the legal basis for the advancement of renewable energy in Germany.

Since enactment, the REA has undergone several revisions to adapt the actual situation to developments, especially the renewable energy market in Germany. In 2000 the REA clearly defined the object of the preferential policy and imposed obligations for implementation. In addition, incentive policies for renewable energy were also defined such as special subsidies and feed-in-tariffs, and were further refined into the REA in 2004. The expansion of the REA to 66 of the 12 clauses in 2009 was aimed at proposing requirements for marketing for the first time. A partial revision of the REA was carried out twice in 2012. The revision aimed to adjust the mechanism for reducing feed-in-tariffs according to new power capacities to encourage the development of renewable energy to enter the market. The strict control of renewable energy and photovoltaic power subsidies carried out in 2014 aims to gradually promote to the market. The restrictions imposed in the latest version of the REA, precisely in 2017 with an annual scale bidding system, were carried out to avoid excessive exploitation of renewable energy, especially wind energy sources. In addition, the fully introduced bidding system for renewable energy power plants indicates that a comprehensive promotion in marketing renewable energy plants can run well [56]. Policies and laws have provided concrete tools, especially renewable energy in Germany. The growth rate of renewable energy in Germany is currently so high that it has never happened before [57–59]. The issuance of scenarios from the German Renewable Energy Federation (REF) can cover 47% of electricity needs from renewable energy in 2020. The REF determines to set targets to be achieved as long as the policy framework is stable and reliable with policy support from the government [60].

Japan is one of the countries that has a very large power in the world in the field of utilization and development of renewable energy. Where the formulation and revision of laws and policies on renewable energy promptly are very important. The principle adopted by the Japanese government "legislation go first" aims to ensure that the law on the renewable energy industry can always be relied upon, especially in an uncertain situation. The Renewable Portfolio Standard put into practice by setting an annual target for electricity retailers of 1.6% of electricity generated from renewable energy sources has been in place since 2003 [61]. The sustainable development of the renewable energy industry has been formulated into the Strategic Energy Plan in 2006 by the Japanese government. In 2014 the Strategic Energy Plan was updated to avoid the Fukushima nuclear disaster. The Japanese government has just agreed in the Energy Outlook up to 2030 by suggesting the right portion for renewable energy which reaches around 22–24% by 2030 [62–64]. In addition, the proposed concept in the use of benchmarks requires electric power companies to be able to complete several obligations in terms of utilizing renewable energy sources and sustainably using them. However, if not, then routine repairs must be prioritized or the company will be penalized with a severe penalty of 1 million yen [65].

Table 2. Countries that have taken effective measures.

Measurement	Australia	Germany	Japan	France	Indonesia	China
Laws that are comprehensive and specific	√	√	√	√	√	√
The high percentage of renewable energy usage	√	√	√	√	N/A	√
Market competition should be encouraged	N/A	√	N/A	N/A	N/A	√
Laws must be formulated and adjusted promptly	√	√	√	√	√	√
Overuse of renewable energy should be avoided	N/A	√	N/A	√	√	√
Subsidies financially	√	√	N/A	√	N/A	√

The use and development of renewable energy on the European continent is one of the largest in France. In 2005 the energy law was enacted to provide guidelines for energy policy requiring the proportion of renewable energy to be 10% of the energy consumption structure in 2010. In addition, the development zone of wind energy sources can be described so that the pricing mechanism can be carried out by the government [66–68]. In 2008 the development of renewable energy is planned for solar panels can produce less than 30 m^2. Where the previous provisions have been revised, especially on the development of wind energy so that wind energy on a larger scale can be encouraged by adjusting the existing area. Green growth in 2014 from the energy transition bill is set to target towards increasing the renewable energy fraction for final energy consumption by 32% by 2030 [69]. Based on the various experiences of the countries mentioned above, the utilization and progress of the development of renewable energy can be caused by the existence of appropriate, appropriate, and scientific renewable energy policies and laws. Effectively these steps can be used as a reference as was done in China. Where the law is adjusted and formulated at the right time and complete and concrete legal provisions. Promotion of high standards for renewable energy utilization, financial subsidies,

market competition, avoidance, and over-exploitation of renewable energy could be better implemented as shown in Table 2.

5. Renewable energy laws and policies are causing problems

The current renewable energy development project has begun to strengthen with the policies and laws from the government. However, there are still some countries that are not sufficient to integrate various renewable energy sources into their national energy systems. However, efforts to increase the development of renewable energy sources have increased.

The complexity of the policy and legal system for renewable energy has had a particularly clear picture in China. However, there are still some difficulties in its implementation such as laws and policies for regulating renewable energy. In addition, laws at the central and regional levels as well as specific and general laws are also obstacles to the development of renewable energy. Therefore, the biggest problem for various regulations lies in the existing regulatory system. As an example; the existence of renewable energy sources in the area under the management of the NEA. Meanwhile, geothermal, hydropower, and marine energy sources are under the supervision of the Ministry of Water Resources, the Ministry of Land and Resources, and the State Maritime Administration. If the institutional separation is carried out, it will cause various situations. Where the renewable energy system program must pass approval and several tests from different departments so that it will be a very big risk. Moreover, the formulation of various rules must go through several departments so that the results are inconsistent with one another. For example, the issuance of Administrative Provisions for Renewable Energy Power Plants with notifications made by the National Development and Reform Commission. Thus, the determination of the power generation company must first apply so that the connection to the electricity network can be carried out as long as there is an administrative permit. In addition, the law on electricity must have a single law on power generation. Furthermore, existing policies and laws have exacerbated and confused their complexity. The regulations and administrative rules that exist in China are not sufficient, especially those related to the use and development of renewable energy other than those contained in the REL. There are many provisions contained in the REL, but they are principles without a strong legal basis. Thus, operations in particular only depend on existing policies. However, this policy can provide advantages in promoting renewable energy that is faster and more flexible, especially in the long term. Modified policies cannot stabilize the obligations and rights of renewable energy producers, but existing legal authorities can be weakened [70–73].

Several laws in China do not operate properly apart from the flawed legal system. For example, an explanation of the principle of general provisions. Where in general, further explanation is how to apply certain operating systems and special circumstances. In addition, at the time of setting up the network or connection. Where the implementation of electricity network operators carried out by EEG generally should connect facilities from renewable energy generators to access points of the electricity network without experiencing obstacles. A certain operating system as a whole can explain what procedures must be taken by the electricity network operator. How long does it take for a network connection request to be handled and what kind of responsibilities should the power grid operator have to bear in the event of a failure and what are their obligations? Several laws laid down in Japan have definite penalties against electric power companies that fail to utilize them [74–76].

However, most of the existing provisions cannot be implemented by the government, especially in China. This is because the provisions related to renewable energy are too generalized and principled

so there is a delay in starting them. The state's requirement to support and encourage the synchronization of the electricity grid as stipulated the article 13 of the REL can be generated using renewable energy. However, the results obtained cannot be dealt with specifically in applying these provisions. State arrangements in carrying out responsibilities for energy conservation and inspections of energy conservation as regulated Article 6 of the ECL can be used to complete energy conservation goals. This can be used as a consideration for evaluating and assessing the performance of local governments and responsible superiors. The article does not explain in detail the purpose of the energy conservation target. In addition, it is not known who can evaluate the targets achieved and the process carried out has not been described. It is also not known whether the local government or the person in charge is responsible for it. Thus, the laws and additional regulations that have been made have not been able to provide a more detailed explanation.

The monopoly system of regional and industrial markets is the biggest obstacle to a reform of the renewable energy industry that is taking place as is the case in China. Conventional energy has evolved over the past few years and until now still occupies a monopoly system position at the market level. The main tax payments in the local area are generated from the traditional energy industry and even the local government has invited various investors to invest with preferential policies. This is the difficulty experienced by renewable energy to penetrate the market. The north-western, eastern, and northern regions of China have rich energy resources and so far, have not been able to convert them at the local level. This abundant availability of renewable energy should be transmitted to the eastern and southern regions of China because the demand for electrical energy in the region is very large. The transmission system can be done with extra high voltage transmission lines. To protect the power plants owned and industry, the Chinese government, especially the eastern and southern parts, is reluctant and even unwilling to receive electricity from being transmitted. This is due to the existence of a local system of protectionism. Meanwhile, the installed thermal power plant capacity has increased since 2016. This explanation is not in line with the current trend so that power generation space can be depressed, especially for renewable energy. There are several fields of renewable energy that are still under the monopoly of the state, mainly because of the exploitation of renewable energy which has a big risk. Massive investments have been made by almost all private companies. It is hoped that this is just a tactic because the current renewable energy system is not yet fully developed. The principle of the market in the long term must play and be the main role so that access to renewable energy sources can be owned by the community in general which is more affordable and stable.

Barriers to the development of renewable energy can be due to inadequate subsidies. The use and development of renewable energy require very high costs compared to conventional energy. However, the availability of finance to support the development of renewable energy is very limited. While the exploitation of fossil fuels is excessive [77–80]. Renewable energy should have a larger additional fund each year so that it can adjust to the number of subsidies provided. Meanwhile, the amount collected is far greater than the subsidy provided. Power generation in most companies shows a refusal to pay additional taxes on renewable energy. However, in this case, the punishment cannot be given as is the case in Japan. By the end of 2017, the gap in subsidies provided for renewable energy had started to grow to reach around 200 billion Yuan in 2020 as reported in the study [81].

Wind and solar power plants have begun to be abandoned in some areas [82–84]. At first the energy sector in China was established specifically for fossil fuels in operating and managing large energy grid and power systems. This has discriminated against renewable energy due to intermittent fluctuations in production. Inadequate power grid transmission systems have resulted in the occurrence

of interconnections at every power plant and electrical energy grid. Renewable energy generally cannot be consumed or exported at the local level [85–87]. The phenomenon that occurs every year energy from renewable energy sources is wasted and not utilized. For example; energy from wind power discharged in 2015, 2016, and 2017 averaged 15%, 21%, and 12%, respectively, especially in China [88–90]. Meanwhile, in 2017, what happened in Xinjiang, Mongolia, Jilin, and Gansu showed a more worrying situation in which renewable energy was wasted at 29%, 15%, 21%, and 33%, respectively [91,92]. Regarding the issue of renewable energy being abandoned in general is a manifestation of various political achievements. Projects located in various places of construction have accelerated and subsequently also experienced rapid destruction. A system like this is a huge waste of energy and can be used which is more useful in other sectors [81].

6. In Indonesia, the law and policy on renewable energy are being improved

The growing awareness of mankind to preserve the environment in recent years has begun to increase. This is based on the need for environmentally friendly energy as indicated by global conditions. This trend has led to the utilization of energy derived from renewable energy so that it has answered environmental problems such as greenhouse gases, the use of NRE must be optimized. The population of Indonesia is very large, more than 250 million people. Meanwhile, the growth of electrical energy needs is around 8% per year, and this results in a significant increase in electrical energy of around 7 000 MW/year. Thus, it is necessary to supply security for the availability of energy, especially electrical energy. Indonesia's energy conditions currently reach 90% which comes from fossil fuels. However, the phenomenon of fossil fuels is currently dwindling. In addition, it has also been proven to be an important factor in the occurrence of global climate change [93]. New and renewable energy (NRE) is very important to realize energy security in the future. Moreover, Indonesia has NRE potential that reaches 441 GW, which so far has only realized 8.89 GW [16,94].

The mix of new and renewable energy (NRE) continues to increase, indicating that this sector is increasingly attractive for investment. In 2014, the value of NRE investment was around IDR 8.63 trillion, then increased in 2015 to IDR 13.96 trillion. Last year, the total investment reached IDR 21.25 trillion. Total NRE investment until October 2017 reached IDR 11.74 trillion. The energy capacity of the NRE sector continues to increase. The installed capacity of the Geothermal Power Plant (GPP) until October 2017 has reached 1,808.5 MW. Solar Power Plants (SPP) and Mini Hydro Power Plants (MHPP), now have an installed capacity of 259.8 MW. Meanwhile, the Bioenergy Power Plant has a capacity of 1,812 MW. Meanwhile, the current condition of electricity sourced from new and renewable energy and the target for 2025 is shown in Figure 3.

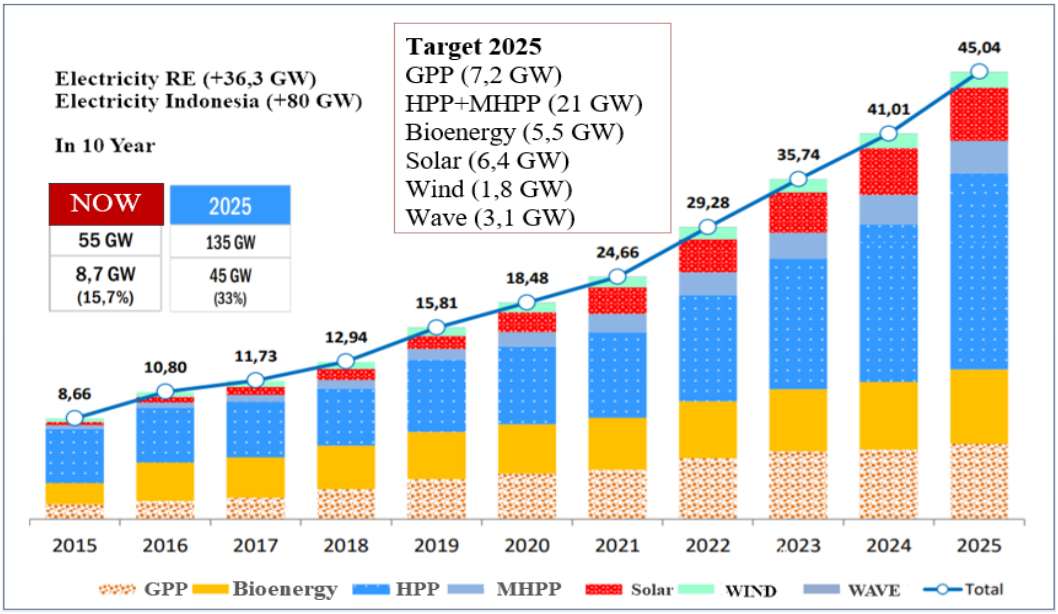


Figure 3. The current state of renewable energy and Indonesia's 2025 energy target.

Renewable energy development in Indonesia is still dominated by hydroelectric power, bioenergy, and geothermal power plants. However, the development and utilization of renewable energy are still very minimal compared to its abundant potential. The development of the renewable energy industry is also still very little compared to developing countries such as Germany, China, Japan, France, Australia, etc.

Indonesia has abundant renewable energy reserves which are found in almost all regions or provinces. The potential of renewable energy in Indonesia is very adequate to replace fossil energy which is dwindling from year to year. Where oil reserves currently still leave around 3.6 billion barrels with a production level of 288 million barrels per year. Meanwhile, natural gas reserves are still around 100.3 TSCF with an annual production rate of 2.97 TSCF. The availability of oil is estimated to only be left for the next 13 years and natural gas for about 34 years. The potential of renewable energy sources in Indonesia, which is currently abundant, is still not optimally utilized and has only reached 8.88 GW as shown in Figure 4.

The National Energy Policy or KEN has been established on October 17, 2014, through Government Regulation Number 79 of 2014. The stipulated KEN has also been approved by the DPR through DPR Decree Number 01/DPR RI/III/2013-2014. KEN is a guideline to provide direction for national energy management to realize energy independence and national energy security to support sustainable national development.

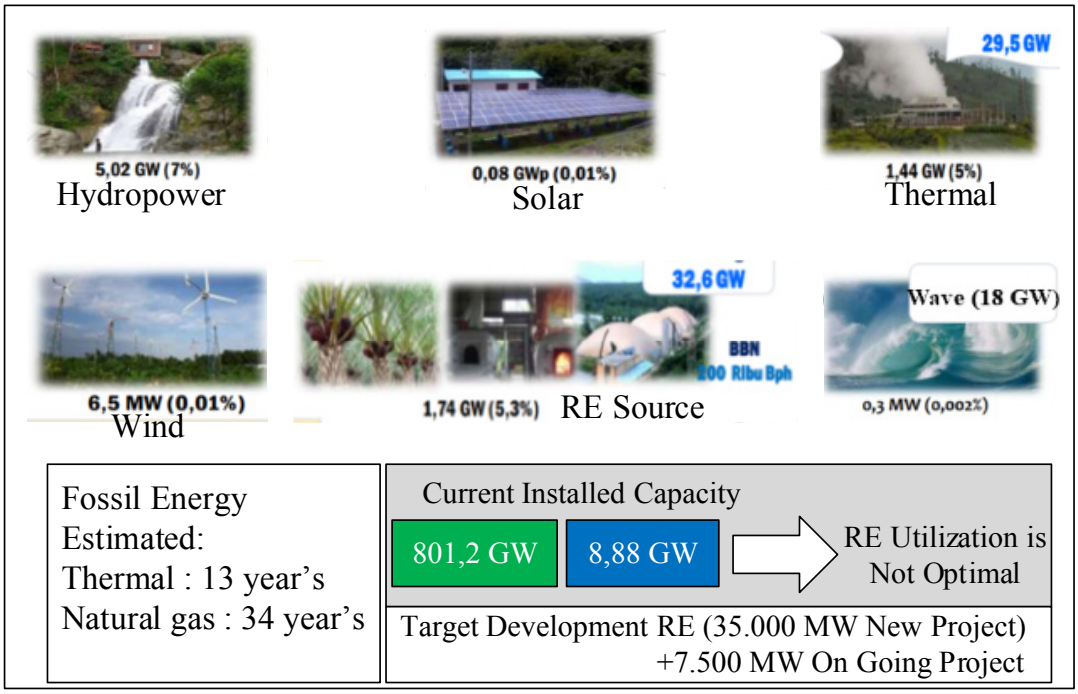


Figure 4. Renewable energy potential in the future.

The future direction of energy policy is guided by the paradigm that energy resources are no longer used as mere export commodities, but as capital for national development. The objectives are to (a) achieve independence in energy management, (b) ensure the availability of energy and the fulfillment of domestic energy source needs, (c) optimize the management of energy resources in an integrated and sustainable manner, (d) improve the efficiency of energy use, (e) ensure fair and equitable access to energy, development of technological capabilities, the energy industry and domestic energy services, (f) creating job opportunities and controlling the impact of climate change and maintaining environmental functions.

In 2025 the role of New and Renewable Energy is at least 23% (twenty-three percent) and in 2050 at least 31% (thirty-one percent) as long as the economy is fulfilled. In 2025 the role of petroleum is less than 25% (twenty-five percent) and in 2050 it will be less than 20% (twenty percent). In 2025 the role of coal is at least 30% (thirty-five percent) and in 2050 at least 20% (twenty-five percent). In 2025 the role of natural gas is at least 22% (twenty-two percent) and in 2050 at least 24%. Meanwhile, national energy in Indonesia is still dominated by oil and gas. An important role as an energy source in the future and the projection of Energy utilization in the National Energy Policy (KEN) as shown in Figure 5.

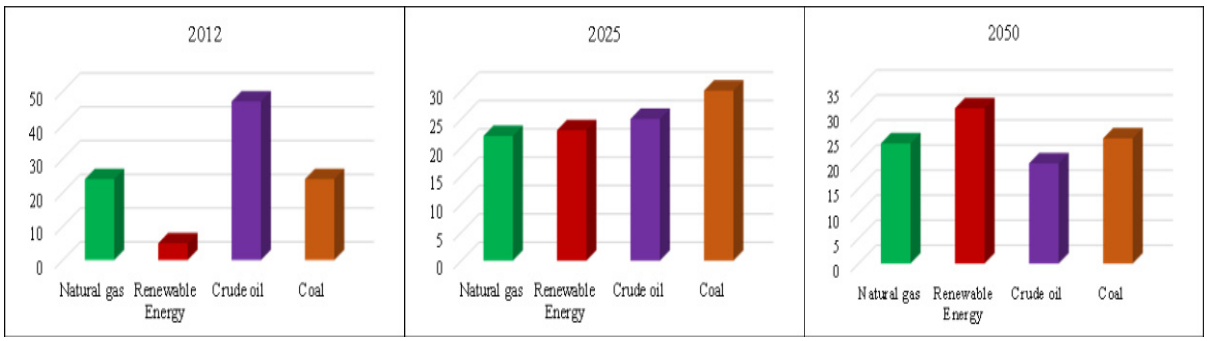


Figure 5. Energy utilization projection in national energy policy.

The priority principles of Indonesia's national energy development in the future are focused on:

- Maximize the use of renewable energy;
- Minimize the use of petroleum;
- Optimizing the use of natural gas and new energy;
- Using coal as the mainstay of national energy supply;
- Using nukes as a last resort.

7. Barriers and challenges to renewable energy development and energy conservation

The development of renewable energy in Indonesia has several obstacles and challenges resulting in delays in its implementation. Some of the obstacles that can be summarized are as follows:

- The price of renewable energy production is relatively more expensive compared to energy derived from fossils;
- There are still a lot of new renewable energy technologies that need to be imported;
- Lack of funding for new and renewable energy projects;
- The limited quantity and quality of human resources that control new and renewable energy;
- Public understanding of new and renewable energy is still low because most people are still comfortable with using conventional (fossil) energy;
- Several regulations are not yet strong enough to become a legal umbrella for the development of new and renewable energy, they are still sectoral: The Geothermal Law, the Energy Law, etc;
- Investor interest still needs to be increased and banking confidence in this sector is still low.

8. Recommendation

Indonesia still relies on energy from non-renewable fossils whose production is decreasing day by day. Along with the growth and increase in economic activity, the need for energy is increasing, for this reason, it is necessary to diversify energy resources by exploring the potential of new and renewable energy sources.

- To accelerate the development of new and renewable energy, the government must provide clear policies and laws to the developing industry;
- Setting sanctions against entrepreneurs developing new and renewable energy;
- The government requires the use of new and renewable energy by 2030;

- The government should provide incentives for the successful development of new and renewable energy;
- The government must provide legal guarantees to investors in developing new and renewable energy;

Based on these recommendations, the government needs to make policies to ensure the development of new and renewable energy industries. With permanent policies and laws from the government, the renewable energy development industry cannot play and only take profits. To strengthen policies and guarantee investors, the government has made regulations that can meet energy needs by 2025.

Presidential Decree No. 5 concerning the National Energy Policy is the starting point for Indonesia's perspective on the energy sector, especially with the existence of Vision 25/25 which wants a significant increase in the use of new and renewable energy by 25% by 2025. This legal basis was later strengthened by the issuance of Government Regulation no. 79 of 2014 concerning the National Energy Policy (NEP) which explicitly provides a target of the energy mix originating from renewable energy of at least 23%. And this PP is a product of an agreement between the Government and the DPR RI as mandated by the energy law. The DPR RI together with the Government needs to prepare a stronger legal umbrella for the development of new and renewable energy and in parallel prepare derivative regulations from the Law (Government Regulations, Presidential Regulations, and Ministerial Regulations) for the implementation of the Law. The government needs to pay attention to the justice of energy development for remote areas, underdeveloped areas, frontier areas, remote areas, and small islands, where until now some of them have not experienced electrical energy to support their lives. The government needs to strengthen the evaluation and monitoring of the programs it implements so that the programs that are run can run well and the benefits can be felt by the community, especially electricity for remote communities so that it can run sustainably.

9. Conclusions

The demand for renewable energy has increased significantly in recent years, especially in developing countries. This increase in demand for renewable energy is inseparable from the result of a strong expansion and modernization of the global economy. The economic development of the community is hampered due to the scarcity of energy and environmental degradation. In addition, the COVID-19 pandemic that has hit the world in the last two years has also triggered the community's economy to decline. One of the solutions to improve the community's economy today is by utilizing new and renewable energy. Renewable energy sources are currently very abundant throughout the world, and also Indonesia in particular. The utilization and development of renewable energy is a solution to balance energy security, economic improvement, and environmental protection. However, currently, the use of renewable energy and its developers is still very small compared to its abundant potential. Energy systems in the future have enormous potential from renewable energy sources. This is because the technology for the development of renewable energy is increasing. Investors in renewable energy development are also increasing with the trust from the government and the community's economy will also increase. Where the government has required a larger portion of the use of renewable energy. The laws and regulations set by the government on the use of renewable energy have been taken seriously. The government has determined the integration of policies and legal frameworks on renewable energy. This is done to increase the renewable energy market by offering to

fund the construction of power plants based on renewable energy sources nationally. The obstacles to the development of renewable energy at this time are inadequate funding in addition to policies and laws that have not improved. With government policies in favor of investors, industrial development from renewable energy sources will be completed more quickly so that the community's economy will immediately improve, especially after the Covid-19 pandemic that hit the whole world.

Conflict of interest

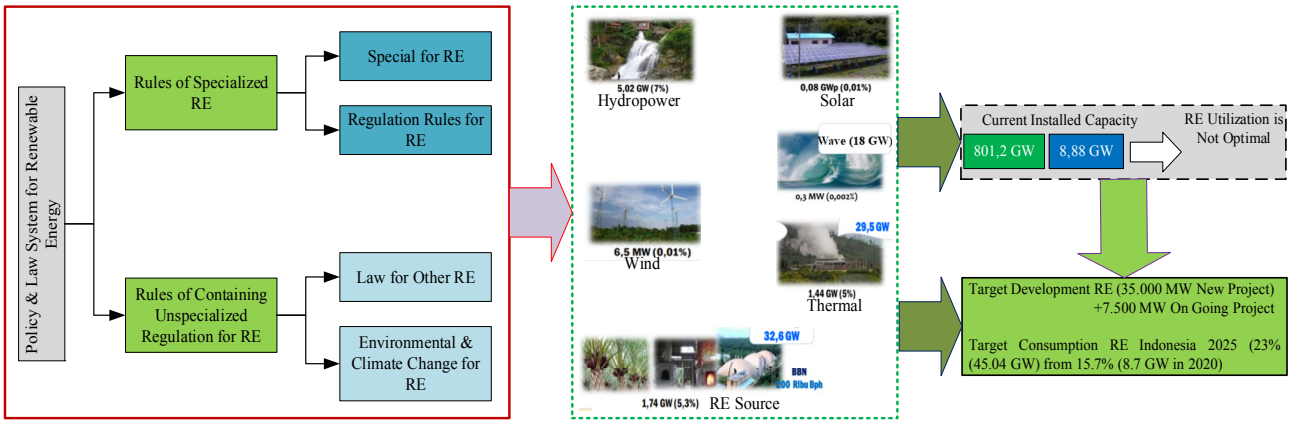
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This research was partially supported by [My Supervisor]. We thank colleagues [All Authors] who have provided insights that are very helpful in research so that this writing can run smoothly.

Appendix

Graphical Abstract



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