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Policy and Strategies of Tariff Incentives Related to Renewable Energy: Comparison between Indonesia and Other Developing and Developed Countries

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Abstract: The transition from conventional fossil fuels to renewable energy is necessary, along with the increase in energy consumption and the decline in national energy production. In its application, increasing the renewable energy mix has many challenges, especially cost-efficiency. Thus, to make renewable energy competitive and achieve a significant acceleration of the mix, massive energy incentive policies are being studied and developed. This study provided a specific overview of policies and strategies for tariff incentives related to renewable energy, particularly in developing and developed countries. An essential section of this study discusses the comparison between Indonesia and other countries, as well as the current status and an ideal policy related to renewable energy for this country. The implementation of energy incentive policies in each country is quite different, depending on the potential, technological readiness, and political and economic conditions. Compared with other policy mechanisms such as RPS, FIT policies are more efficient at increasing capacity and stimulating R&D inputs to reduce costs. In terms of the stage of economic development and characteristics of the electricity system, the price adjustment model, such as that used in East Asia, is more suitable for application in Indonesia than other models.

Keywords: feed in tariff; policy; renewable energy; economic; technology

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Citation: Supriyanto, E.; Sentanuhady, J.; Hasan, W.H.; Nugraha, A.D.; Muflikhun, M.A. Policy and Strategies of Tariff Incentives Related to Renewable Energy: Comparison between Indonesia and Other Developing and Developed Countries. *Sustainability* **2022**, *14*, 13442. https://doi.org/10.3390/su142013442

Academic Editor: Samuel Asumadu-Sarkodie

Received: 6 September 2022
Accepted: 13 October 2022
Published: 18 October 2022

1. Introduction

The transition from the use of conventional fossil power plants to alternative renewable energy (RE) sources, such as solar, wind, and biomass, is desired to achieve energy production with increased sustainability. However, the technologies applied in these alternative power plants are relatively new and still need numerous improvements to be as cost-efficient as conventional plants. Conventionally produced energy is usually preferred to renewable energy because the cost is a great concern to many people. Consequently, grid parity, the condition in which the cost of RE becomes competitive, must be achieved to enable the transition to RE [1]. In recent decades, world governments have become involved in achieving grid parity by implementing policies to accelerate the transition to RE [2–4]. One of the most popular policies is the feed-in tariff (FIT) mechanism [5–7], which allows electricity produced by using RE plants to be purchased by the final consumers at a low price by introducing subsidies to compensate for additional costs [4,8]. The subsidy amount is expected to decrease over time as the technology matures until grid parity is finally achieved [9]. The type of technology used for energy generation might also affect the amount of FIT payment, source availability, project size, and energy transmission costs [10,11]. The economic aspect of RE generation technology is referred to as its levelized cost of electricity (LCOE) [12].

Although an energy generation project's economic viability can be evaluated using various metrics [13–15], LCOE is the most often used metric when comparing various power-generation technologies or considering grid parity for a newly developed technology. The calculated LCOE results are generally compared with the specific costs of alternative energy sources (e.g., LCOE 0.18 USD/kWh for photovoltaic (PV) systems vs. 0.23 USD/kWh for grid-generated electricity using coal) to assess which technology is the most advantageous over others. If the LCOE is less than this specific cost, then the investment in the technology is considered profitable and not otherwise [16]. Suppose the LCOE is equal to the specific cost. In this case, grid parity, which is a condition wherein the price of electricity generated from alternative energy (e.g., geothermal, hydro, and solar energies) is the same as the price of the electricity generated from conventional thermal energy (coal and natural gas), will be achieved [17]. The results of this LCOE comparison also play an important role in determining the FIT [18].

The determination of FITs requires limitations, including the type of RE technology, large generating capacity, resource quality, generator location, national policy, and the instrument related to it. The characteristics of the RE policy that can be implemented by the government can be seen in Table 1. The duration of the PPA has a time limit, which is generally 15–20 years based on the generator type. The function of making FIT is to support the improvement in new and renewable energy (NRE) such that regulatory changes will be met when these goals are met. Several financing schemes are available. In these schemes, funds are taken from the government as incentives, while funds are taken from consumers as electricity users. In the implementation, the government provides several types of incentives that are issued in several forms: research and development, fiscal and tax, market development, grid connection, and tariff incentives. The energy incentives given in this situation may include RE production and storage technologies [19].

Table 1. National policy instruments related to RE (adapted from ref. [20]).

<table>
<tr><th colspan="2">Government R&D Policy</th><th colspan="2">Development Policy</th></tr>
<tr><td>Fiscal incentives</td><td>R&D funding, tax credits, grants, prizes, public research center</td><td colspan="2">Grants, energy production payments, rebates, tax reductions, tax credits</td></tr>
<tr><td>Public finance</td><td>Loans (soft or convertible), public equity stakes, public venture capital funds</td><td colspan="2">Equity investment, guarantees, loans, public procurement</td></tr>
<tr><td rowspan="4">Regulatory policies</td><td rowspan="4">-</td><td>Quantity-based instrument</td><td>Quota obligations, such as RPS, and competitive bidding scheme</td></tr>
<tr><td>Price-based instrument</td><td>FIT, feed-in premium, investment subsidies</td></tr>
<tr><td>Quality-based incentives</td><td>Green energy purchasing program, green labeling program</td></tr>
<tr><td>Interconnection regulations</td><td>Net-metering, priority or granted deed access, priority dispatch</td></tr>
</table>

Many studies on energy incentives have been conducted, with the majority of them focusing on energy savings and cost-effective-efficiency policies [21,22]. However, studies on this topic are still being conducted in developed countries, including in Asia (Japan, China, and Korea), countries in the European Union, and the United States. As a result, it is necessary to conduct more in-depth and thorough research on energy incentive schemes, particularly in developing countries, in order to accelerate the renewable energy transition process while minimizing socioeconomic risks. The many forms of incentives offered for a basic framework are heavily impacted by each country's social, economic, and technical situations. The differences in these conditions have implications for the outcome of policy scenarios that differ in accordance with the developmental needs of each country. This study focused on the model scenarios of independent power generation incentives in terms of economic, sociocultural, and geopolitical aspects and compared the conditions between developed and developing countries.

2. Methods

The tariff incentive scenario models of several countries were analyzed under the countries' economic, sociocultural, technological, and geopolitical conditions. For each country, two scenarios were made: the worst condition, wherein tariff incentives are completely removed, and the ideal condition, wherein tariff incentives are properly distributed. All scenarios were compared by employing a qualitative international benchmarking method based on the problems and conditions of a specific country to determine the most ideal tariff incentive scenario model. In this case, the study will focus on a literature review with qualitative secondary data processing. The FIT scheme is benchmarked in several countries where it has been implemented. The international benchmarking method is a systematic comparison method for analyzing the best working procedures to minimize risk. The limits, successes, and obstacles of each country are observed. International benchmarking related to FIT has been conducted in Germany, Japan, Thailand, United Kingdom, and several other countries experiencing problems. The comparison countries are divided into two categories, namely developed countries and developing countries. This categorization is intended to provide an overview of the differences in the programs of the two countries so as to produce the right program for countries with the same characteristics.

3. Results and Discussion

3.1. Scenario Model in Developed Countries

3.1.1. Germany

The German government has been promoting RE generation by using the Energy Sources Act (EEG) regulation since 2000. The implementation of this policy has led to an increase in the installed RE plants in Germany, with decreasing FIT costs over time. As one of the earliest users of this policy, Germany has been considered as a role model for other countries in making RE policy [23–25]. In this policy, the FIT incentive is to be given to electricity producers, which is usually a private entity that is determined by an auction. The FIT cost is charged to consumers, which includes household electricity consumers, via the EEG levy [25,26].

Solar PV energy is one of the most popular RE generation technologies in Germany. It is accepted widely by the public because it can be installed easily and does not generate any kind of disturbance. However, some problems also arise when the RE interest increases. Given that PV technology has still to reach grid parity, its cost remains higher than the costs of traditionally generated electricity. On the other hand, despite only making up to 6% share of gross electricity production in 2015, PV technology shares the highest proportion of the promotion fund (43.4%). The increase in the number of PV plants has led to an increase in the FIT payment that is charged to the consumers, mainly industrial and regular households [25].

3.1.2. Italy

Italy has implemented a FIT scheme since 2005 that is similar to that of Germany. This scheme has a guaranteed incentive payment for 20 years. The policy has been considered to contribute to the increase in Italy's under-average RE share among European Union members in 2007 to its 2020 target four years earlier, despite the fact that the majority of EU countries, including Sweden, Estonia, and others, have met their targets before 2020. The policy gives several options to electricity producers to choose their FIT agreement:

A decrease of 6% to 8% from the original relevant FIT rates.

A tariff decrease of 17% to 25% in exchange for a four year payment period extension. A great decline in the first term, followed by a rise in later years [27].

3.1.3. China

China's PV subsidy program has undergone four main revisions after multiple trials and mistakes. Prior to 2009, the central government granted FITs for PV projects on a case-by-case basis due to limited volumes and the lack of reliable cost data. Between 2009 and 2011, concession incentives were utilized to attract PV investment for concentrated PV projects, whereas an upfront discount was offered for diffused PV projects. After 2011, China implemented a nationally consistent FIT scheme that mandated the same tariff rates for all PV plants; the program began at 1.15 yuan/kWh (0.16 USD/kWh) and eventually decreased to 1 yuan/kWh (0.14 USD/kWh) in 2012 [28].

The zone-based FIT policy (for concentrated PV plants) went into effect in 2014 after its adoption in August 2013 [29]. This strategy split the Chinese mainland (save for Tibet) into three different zones (Figure 1) based on the distribution of solar irradiation resources in China. Zones with greater solar resources receive lower tariffs than those with lesser solar resources to ensure that PV plants across the country have a comparable net present value. As a result, the best solar resource region in northern China is in Zone 1 and has the lowest FIT rate. By contrast, the weakest solar resources in central and southern China fall within Zone III and have the highest FIT prices. Zone II includes the northeast and other areas of China.

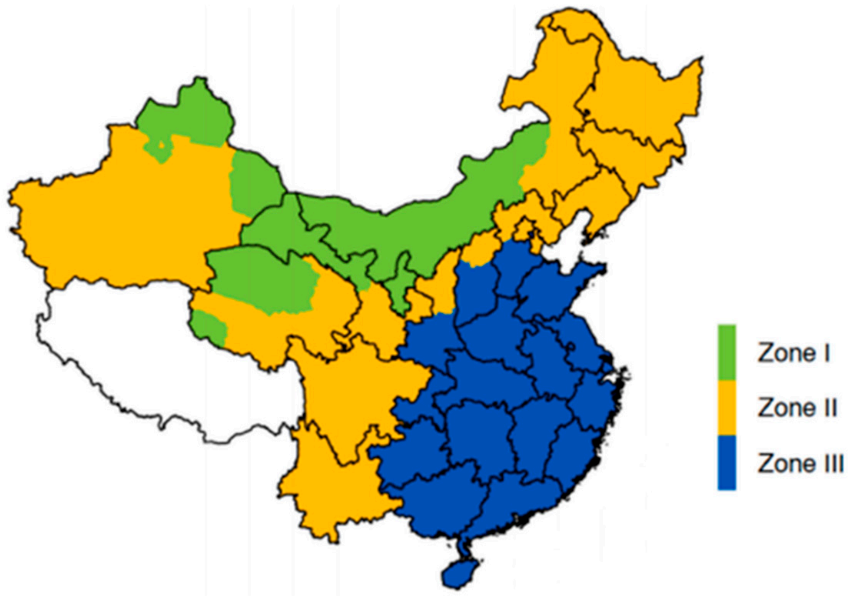

Figure 1. FIT zones for PV solar power in China (modified from ref. [29]).

Figure 2 summarizes the dynamic revisions to China's FIT policy throughout time. During the standard FIT period of 2012–2014, all three resource zones earned 1.0 yuan/kWh (0.14 USD/kWh) for selling solar electricity to the nation's grid. A new zone-based FIT policy with reduced FIT rates for Zones I and II was implemented beginning in January 2014.

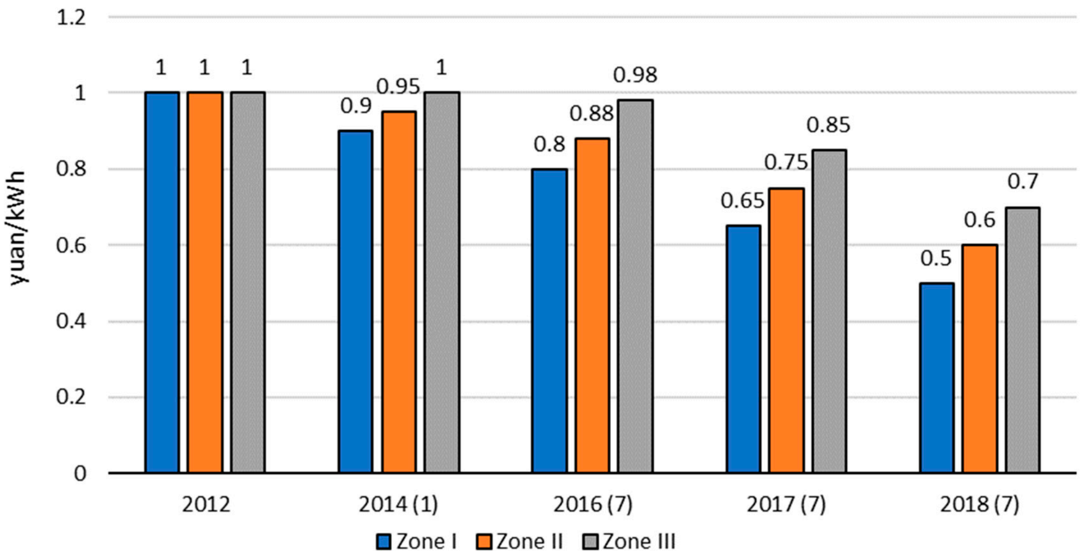

Figure 2. FIT zones in China from 2012 to 2018.

Although adjustments to FIT levels across all zones occur on the same day, the magnitude of the changes varies between zones. Figure 2 reveals that the highest shift in FIT levels occurred in Zone I between early 2014 and mid-2017, whereas the smallest occurred in Zone III and was mostly done in 2015 and 2016 to avoid overinvestment in resource-rich regions, such as Zone I. However, the significant decline in a FIT during this period caused PV industry players to suffer substantial losses [30].

3.1.4. Japan

The rapid progress of RE development in Japan is inseparable from the pressure of energy transition. This is due to the depletion of fossil energy supplies and environmental difficulties associated with the use of this energy source, since Japan remains largely dependent on fossil reserves, with a total consumption of 490,000 kiloliters, which tends to decrease year after year [31]. Moreover, the issue of emissions is a major focus because Japan is one of the largest emitters, with a GHG value of 1100 Mt, which makes Japan the fifth largest CO_2 emitter in the world [32]. With this fact, Japan is gradually undergoing an energy transition by switching to RE sources, such as solar energy, geothermal energy, and mini-scale hydropower. These RE sources have become increasingly popular since the nuclear catastrophic disaster in Fukushima in 2011. Development has also focused on reactor-based nuclear energy sources, which is targeted to reach 20%–22% by 2030 [33].

The FIT scheme has been successfully implemented for solar energy sources. This policy was initiated more than a decade ago. The FIT scheme in question is a mandatory policy for utilities to purchase surplus solar electricity for 10 years with a value that is almost twice as high as the electricity market price for residential PV installations below 10 kW [34]. This situation makes Japan the country with the third largest solar capacity after China and the USA, with a total fleet of 63.2 GW in 2019, capable of producing 74.1 TWh of electricity and a net capacity of 8.7 GW in 2020 [35]. Japan is developing other RE technologies, such as biofuel, waste-based energy, and wind energy in addition to the above RE sources. In this case, hydropower plays an important role by being the main source of energy (57.1%), followed by solar PV (32.6%), then wind energy, biomass, and geothermal energy [36]. The development of this RE trend is inseparable from various government policies in accelerating the RE mix. In recent years, Japan has switched from a FIT scheme to an energy auction. This scheme is principled like a tender that is then implemented in the form of a support mechanism or policy instruments, wherein various project developers can compete by submitting a grid development proposal that is then evaluated and selected by the government [37]. This scheme is very flexible and can be adapted to the needs of a particular country such that it can be successfully implemented. Along with the energy auction scheme that was first conducted in June 2020, Japan also introduced the feed-in premium (FIP) scheme that will also accelerate the RE mix in Japan.

3.2. Scenario Model in Developing Countries

Malaysia, Philippines, Thailand, and Vietnam principally set their FIT based on averaged energy costs (LCOE) plus some premiums that provide a return on investment for various technologies. By contrast, in Indonesia, FIT is being replaced with a new incentive scheme that is defined by ceiling prices based on local and national electricity generation costs.

3.2.1. Malaysia

FIT prices decrease as capacity increases due to cost optimization of economies of scale. The application of FIT for NRE in Malaysia is based on the available quota set by the government each year. In Malaysia, FIT for all RE (except for small hydroelectric power plants) is applied at an annual rate of decline. This decline in FIT begins every new calendar year from 2013 onwards. This rate will not be reduced again once the start date is reached. The quota for FIT submissions for solar PV ended in 2016 because it had met the SEDA target. The government then switched to self-consumption schemes for solar PV through net energy metering and large-scale solar power. The FIT for biogas and biomass that has been in effect since SEDA announced 2012.

An initial fund of USD 63 million was taken from taxation, and an additional 1% was taken from electricity sales with a consumer limit of above USD 16.2 per month or above 300 kWh per month. The figure above then changed to 1.6% in January 2014 and absorbed 44% (due to restrictions) of the total sales. The complete data are shown in Figure 3, wherein FIT's effect is illustrated in terms of basic FIT and bonus FIT [38–40].

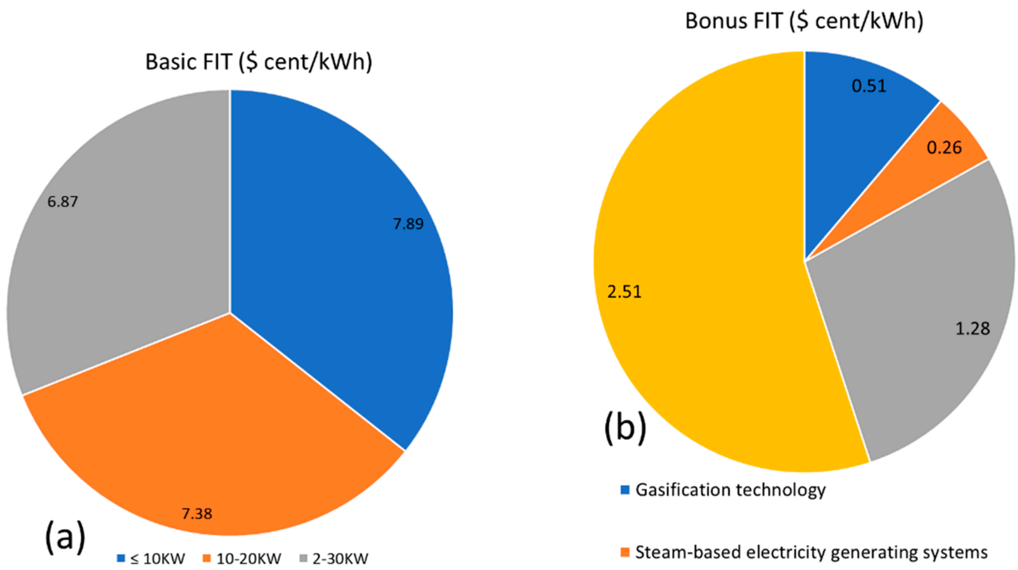

Figure 3. Biomass FITs in Malaysia.

3.2.2. Philippines

FITs in the Philippines are set as a flat rate for various types of RE, as shown in Figure 4. The source of FIT payments in the Philippines is taken from the tariff payer, which is called the FIT allowance (FIT-All). The FIT-All is a uniform fee calculated annually and applied to the kilowatt hours billed to all on-grid consumers who are supplied with electricity through distribution or transmission networks.

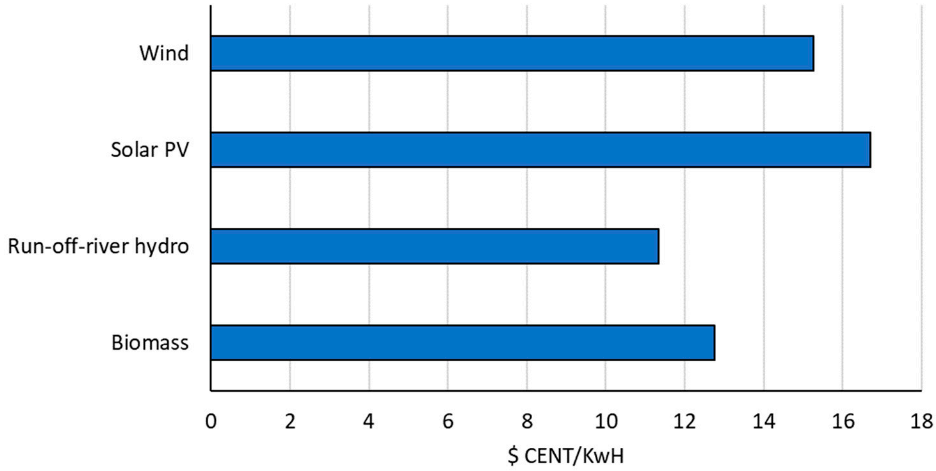

Figure 4. FITs in the Philippines for different RE technologies.

In addition to the commonly used FIT scheme, the Philippines has initiated policies to support the development of RE since 2008 through the net-metering mechanism, renewable portfolio standard (RPS), and green energy incentives [41]. The policy remains focused on solar PVs. In this case, net metering allows consumers to send excess electricity from their RE generators to the electricity provider, which can then be compensated as electricity sales. Meanwhile, the green certificate helps producers with RE products to have assets certified as environmentally friendly so that they can provide added value for producers in their efforts to develop energy.

3.2.3. Thailand

FIT in Thailand as shown in Figure 5 can be classified into two (2) categories based on NRE technology: natural energy (i.e., hydro, wind, and solar PV) and bioenergy (urban waste, biomass, and biogas). FIT for natural energy in Thailand is classified as fixed FIT (a fixed portion of remuneration) and FIT premium (FIP for the three southern provinces). The latest information shows that solar PV FIT was discontinued in 2018 and that regulations are being revised.

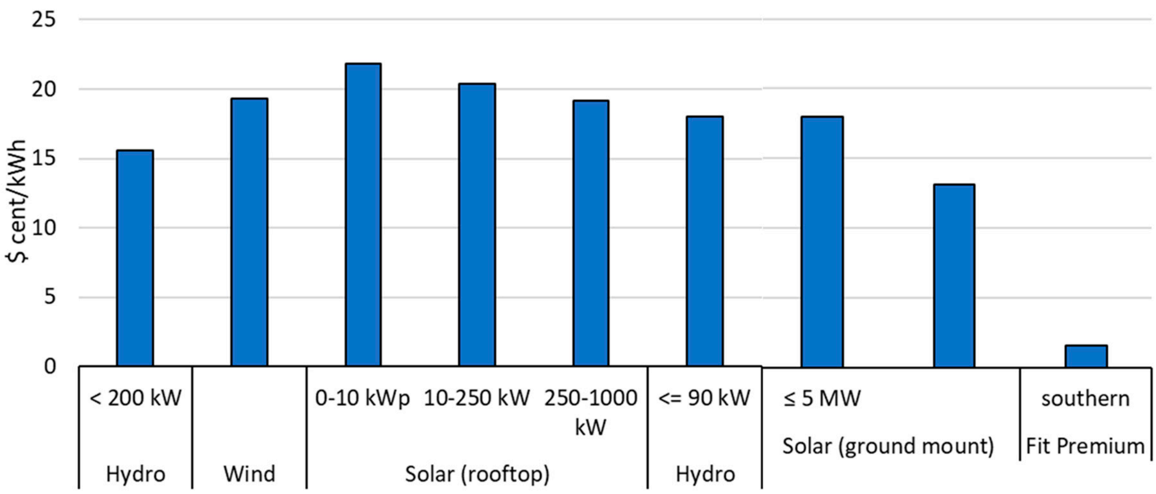

Figure 5. FITs in Thailand for different RE technologies.

In Thailand, FIT is funded by fees that are passed on to all electricity consumers at a uniform cost. This scheme is included in the Fuel Adjustment Cost (Ft) component in determining electricity rates. The Electricity Generating Authority of Thailand is the agency responsible for procuring electricity generated from ET and providing FIT payments to ET electricity producers under the SPP scheme (10–90 MW). For very small power producers (for a capacity of less than 10 MW), electricity generated from NRE must be purchased by the Metropolitan Electricity Authority [42–44].

3.2.4. Vietnam

Vietnam has provided FITs for wind, biomass, waste, and diesel power generation as shown in Figure 6. All RE prices are fixed and not set in accordance with a specific area or installed capacity. Currently, the government is exploring and reviewing FIT for biogas and geothermal energy.

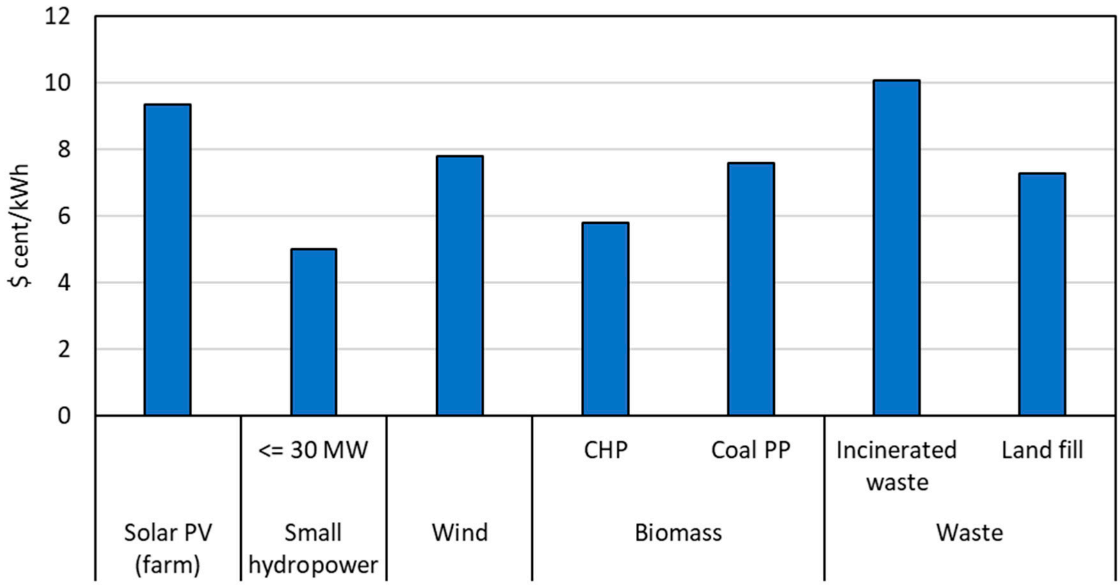

Figure 6. FITs in Vietnam for different RE technologies.

The Vietnamese government obtained the Vietnam Environmental Protection Fund (VEPF) wind power FIT payment of 7.8 USD/kWh. The VEPF pays 1 USD/kWh of this payment, and the Electricity of Vietnam (EVN), a state-owned electricity company, pays 6.8 USD/kWh. In Vietnam, solar PVs have been rapidly developed and implemented with a distributed PV system of 19,105 household installations in 2019 with a concentrated capacity in the industrial sector. In the same year, Vietnam became the solar market leader in Southeast Asia, with installed solar PVs of 5.5 GW or 44% of the total capacity in Southeast Asia [45]. Furthermore, Vietnam has begun to open new policies to meet continuing energy needs through new business models, such as third-party financing and peer-to-peer energy trading, to liberalize the electricity sector progressively with a fully competitive retail market [41,46].

3.2.5. Indonesia

Dependence on fossil energy coupled with increasingly limited sources has encouraged Indonesia to develop RE through various government policies. Indonesia has enormous potential with various new and RE sources. This country's potential for geothermal energy is very large, reaching 29,476 MW, but its utilization is only approximately 2138.5 MW per year 2019 [47,48]. Presidential Regulation (Perpres) number 22 of 2017 concerning the General National Energy Plan set the new and RE mix (NRE) target by 23% by 2025. The very diverse potential RE in the country includes hydropower, wind energy, biofuels (including bioethanol, biodiesel, and biomass), ocean current energy, solar energy, and nuclear energy [47,49].

The development of geothermal energy in Indonesia is encountering obstacles considering that exploration may not necessarily be able to find sources of geothermal reserves such that the cost of the loss is fully deferred by the developer. The government provides support through fiscal incentives intended to cover existing burdens or risks. Fiscal incentive policies in geothermal energy development can include income tax facilities, import duty facilities, and funding incentives [50]. For more than 15 years, Indonesia has implemented several policies for RE incentive schemes, including avoided cost tariffs for small RE producers (1995), competitive rates and tender schemes for geothermal energy development (2003), geothermal funding, and FIT for geothermal energy (2012) [51]. In 2014, the Ministry of Energy & Mineral Resources made guidelines related to the FIT tariff for purchasing electrical energy by PT Perusahaan Listrik Negara (PLN) (Persero) on NRE geothermal, bioenergy, hydro, and solar energy. However, their implementation encountered difficulties because PT PLN (Persero) is required to provide electrical energy at low prices. Meanwhile, the cost of supplying electricity (BPP) will increase if the Regulation of the Minister of Energy and Mineral Resources regarding the FIT for NRE is followed.

Financial incentives are one of the policies regulated in the RE development scheme as shown in Figure 7. Several related policies include the provision of guarantees from state-owned enterprises to engage the private sector in the development of energy infrastructure. Loans in the form of a number of funds can also be provided for exploring geothermal sites that have been proven to be productive. For the development of biofuels, the government can provide loans to farmers who grow energy-producing crops. Government policies also take the form of fiscal incentives, including exemption from import duties and VAT, as well as a reduction in the value of income tax. Then, the government also provides assistance in the form of FITs, guaranteeing the continuity of the electricity business, and public competitive bidding [8].

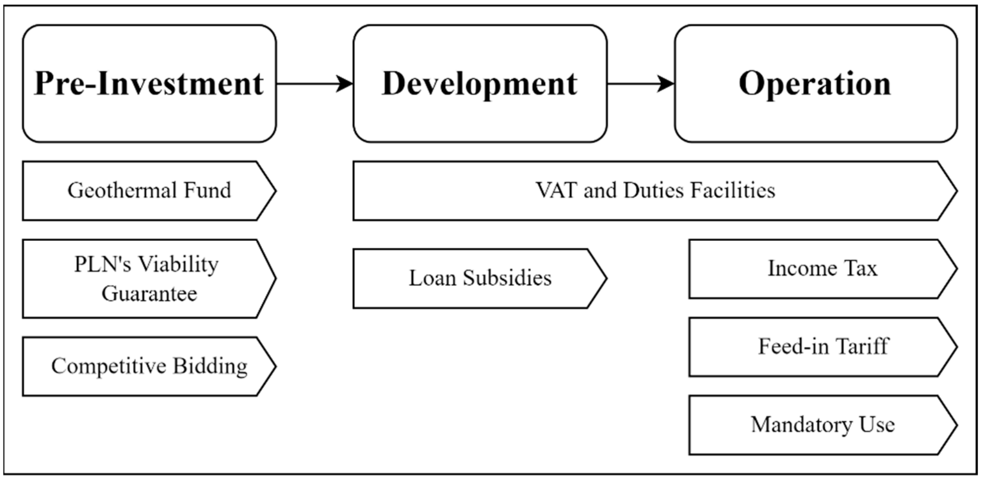

Figure 7. Investment incentives and stages of operation (modified from ref. [8]).

Indonesia has learned to evaluate the implementation of the feed-in tariff on the NRE mix. However, this country focuses on designing a mechanism (amount and scheme) related to the purchase of electrical energy from NRE generators (FIT) that can provide incentives for the development of NRE in Indonesia and at the same time does not burden PT PLN (Persero). Tariffs for purchasing electricity from NRE that are fair to IPP and PLN are calculated by evaluating the financial model of PLN's BPP calculation. The evaluation takes into account critical components in the BPP calculation, such as the cost of acquiring power and renting a generator, fuel expenses, operational and maintenance costs, and personnel and administrative costs. The model evaluation also considers the impact of the NRE target on changes in the Electricity BPP. By considering the NRE target and the Minister of Energy and Mineral Resources regarding FITs for geothermal, bio, hydro, and solar energies, the increase in BPP will be borne by PLN in providing electricity. The juridical aspect will focus on identifying regulatory problems abroad related to the FIT scheme and then identifying existing regulations in Indonesia. A FIT scheme design that is most suitable for Indonesian conditions will be formed based on these limitations. The review of the impact of the FIT policy on PLN by determining the reference price for the purchase of electricity sourced from NRE plants can be seen from the financial aspect. Financially, PLN can save money by purchasing electricity from NRE plants at a lower price than the BPP for local generation, or by replacing/stopping production and renting power plants that use fossil energy, particularly fuel, which has high costs and follows the exchange rate for foreign currency. Therefore, a FIT scheme that can accommodate all off takers is needed. Electricity generated from NRE sources is mandated by the government to be purchased by PLN as a state-owned utility company. The government guarantees FIT funds from the Indonesian State Revenue and Expenditure Budget, of which 85% originates from taxpayers. In 2017, subsidies disbursed for the energy sector totaled IDR 77.3 trillion (USD 5.57 million). PLN, as a state-owned enterprise, is strongly supported by this energy subsidy to develop the electricity sector.

4. Scenario Model Comparison of Several Developed and Developing Countries

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

Couture [8] identified the main objectives of FIT as follows:

- Encourage the small-scale deployment of low-carbon electricity (up to and including 5 MW).
- Empower communities and give them a direct role in transitioning to a low-carbon economy.
- Assist in the adoption of carbon reduction measures by the public.
- Encourage behavioral changes in energy use.
- Help develop local energy supply chains and lower energy costs.

The technologies supported by FIT are solar PV, PLTB, PLTA, and a combination of heat and electricity. Suppliers pay for generation and export tariffs, which are ultimately passed on to consumers via electricity bills.

5. Ideal Scenario Model of Energy Incentives

Worldwide, the FIT policy has become the most widely implemented policy to encourage the spread of RE technologies, as shown in Table 2. The FIT policy guarantees a fixed price and a long contract period, thereby reducing the risk faced by investors. Compared with other policy mechanisms, such as RPS, FIT policies are more efficient at increasing capacity and stimulating R&D inputs to reduce costs [52]. However, they can hinder fair market competition by giving preferential treatment to certain technologies and increasing the financial burden on taxpayers. Usually, the elements of FIT policies include tariff level, rate reduction mechanism (degression), contract duration, and quota limits [53]. Setting the appropriate rate level is a real challenge. High tariff rates attract a high number of investors but they might lead to projects with low financial efficiency and raise policy costs.

Table 2. RE incentive policies in several countries.

Country	Policy Title	Description of Policy	Ref.
United Kingdom	FIT, electric utility quota obligation, tradable REC, heat obligation, capital subsidy, reduction in sales, public investment and loans or grants	FIT and utility quota obligation for PV, wind, and hydro energy PV and hydro tax exemptions	[54]

Table 2. *Cont.*

Country	Policy Title	Description of Policy	Ref.
United States	FIT, electric utility quota obligation, tradable REC, heat obligation, capital subsidy, reduction in sales, public investment and loans or grants, net metering, tendering	FIT only for the states of California, Florida, Hawaii, Maine, and Vermont Almost all states implement net metering, property tax, and loan schemes	[54]
China	FIT, electric utility quota obligation, heat obligation, capital subsidy, reduction in sales, public investment and loans or grants, tendering	FIT support and VAT policy for the solar PV industry FIT for onshore and offshore wind energy and special funding for its industrialization	[54]
Germany	Financial subsidy/loan, market regulation, development plans, FIT, and obligation scheme	The government actively encourages the emergence of new entrants, both household and small power companies, to invest in RE Loans, credits, and high subsidies are provided for the development of the RE industry Electricity prices for energy-incentive industries and rail transport companies are discounted such that high electricity prices do not affect the economy Electricity mix target of more than 35% for new and RE sources	[55]
Taiwan	FIT and subsidies, custom tax reduction, financial support for NRE development	FITs for PV, wind power, biomass, geothermal energy sources with the largest PV incentive because it is in line with the PV potential in Taiwan Subsidies for geothermal exploration with a value of 50% of the maximum cost Demonstration program subsidy for solar PVs with a value of 50% of the maximum installation costThermal solar subsidies for the main and offshore islands in the form of plate- and vacuum-type heat accumulators	[56,57]
Malaysia Thailand	RE target planning, RPS, fiscal incentives, public financing	The Green Technology Financing Scheme is provided in the form of a 2% government offer for interest/profit subsidies for the first 7 years and a government guarantee on green component fees for financial institutions, and fiscal incentives in the form of a green investment tax allowance and a green income tax exemption are provided The RPS scheme is provided in the form of an obligation for electricity suppliers to provide customers with a minimum portion of electricity coming from RE power plants but was later evaluated and replaced with a more efficient scheme, namely, FIT	[58]

Table 2. *Cont.*

Country	Policy Title	Description of Policy	Ref.
Indonesia	Development target planning, RPS, fiscal incentives, public financing, public tendering	RE mix targets in Indonesia are formulated in government policies and presidential directives Funding for geothermal exploration and income tax incentives	[59]
Vietnam	RE target planning, tradable REC, fiscal incentives, net metering/net billing	Net metering with a 1-year banking period scheme which is then evaluated into net billing. In this case, the electricity imported or exported from the site has a different value, wherein the purchase is adjusted to the FIT scheme The electricity generated by household generators, such as rooftop power systems, are allowed to be sold to third parties or electricity supply agencies in Vietnam	[41]

Meanwhile, conservative tariff rates may be insufficient for market expansion and limit technology coverage to only those that operate very efficiently [9]. In addition, the level of the industrial and technological development of each type of NRE can vary such that policies to achieve grid parity should be adjusted to the level of development of each type of energy. At the stage before reaching grid parity (pregrid parity), Germany and Italy experienced a sharp increase in investment until approximately 2011. Since then, increasing investor exposure to policy and income risks has resulted in a slowdown in PV solar investment (and also installation) in the period approaching grid parity (near grid parity). Both countries were in the "Policy Valley of Death" phase at that time, a condition wherein grid parity had been reached but policy makers had not yet realized the side effects of increased risk exposure on investor decisions. The case of Switzerland is different from that of the two countries. Given that Switzerland imposes quota limits on FIT, investment in solar PV in this country remains low ("Tunnel of Frugality").

In the "Policy Valley of Death" phase, three policy options that are shown in Figure 8 [60] can be taken, namely:

(a) Transition to a self-sustaining market, which is a condition wherein the FIT policy is supported by a business model that allows electricity production from solar PVs to be consumed by generators without having to be sold to the state electricity grid. The availability of storage batteries will play a very important role but requires additional investment.

(b) Accelerated climate change mitigation is a condition wherein the state reduces FIT, which allows the state electricity network to obtain additional benefits from reducing subsidies for FIT. In a complementary effort, the government also needs to ensure that the risks faced by investors are reduced. Additional market-oriented policies, such as tradable green certificates, can also be taken. This policy allows investors to earn income by selling green certificates to cover the decline in income resulting from the reduction in FIT [61].

(c) Extended solar eclipse is a condition where policy makers do not make policy changes even though grid parity has occurred. In this phase, solar PV investment and installation are still increasing very slowly.

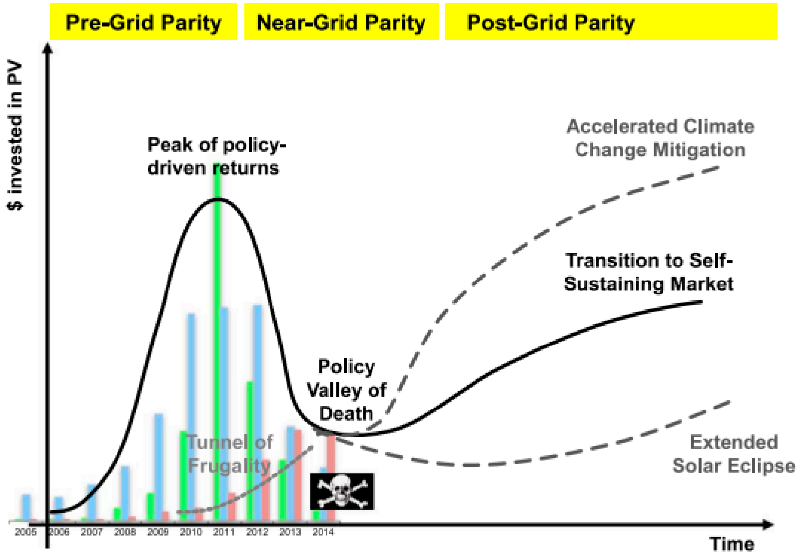

Figure 8. Three steps of grid parity (modified from ref. [60]).

As stated in the Minister of Energy and Mineral Resources No. 17 of 2013, the purchase price of electricity from PLTS Photovoltaic for all capacities is set at 25 cents USD/kWh for the first 10 years and 13 cents USD/kWh for the second 10 years. This situation indicates that the Indonesian government carries out the degression for solar PV in the 10th year. In fact, the rapid development of the solar PV industry and technology causes a continuous decline in the cost of producing electricity from this type of energy.

Several empirical studies in China, such as the works of Tu et al. [61] and Zhang et al. [62], as well as global research works, such as the study of Yao et al. [63], showed that the LCOE declined in 2018. The resulting LCOE is even lower than the FIT in the second 10 years as stated by the Minister of Energy and Mineral Resources No. 17 of 2013 (0.13 USD/kWh). This situation means that the FIT level for solar PV needs to be reviewed for price adjustments/updates. The updated FIT rate guarantees a fair price for IPP and PT PLN (Persero) because it allows investors to obtain a reasonable profit level while the government does not bear the burden of unnecessary subsidies. Adjusting FIT prices/levels is also a common practice in other countries, such as countries in Europe and East Asia (see Table 1). Considering the terms of the stage of economic development and characteristics of the electricity system, the price adjustment model (carried out annually by the government), such as that used in East Asia, is more suitable for application in Indonesia than other models. In Indonesia, policy discussion must be carried out in stages and involve all stakeholders for the price adjustment to be accepted by investors and not harm the industry (as experienced by the solar PV industry in China).

Borozan [64] studied the novel evidence of policy-induced uncertainty effects on renewable energy consumption after controlling for income, institution, and innovation in G7 countries from 1997 to 2019. The study showed that developing an appropriate institutional framework and reducing transaction and adjustment costs linearly make renewable energy more competitive, affordable, and secure. Furthermore, increasing government R&D spending on renewable energy has a beneficial impact on renewable energy use. Obviously, time, political stability maintenance, and predictable policy responses are required for the results to manifest. In this case, the investments and the continuity of RD&D energy must be increased to help accelerate the renewable energy mix. Sun et al. [65] analyzed fiscal and monetary policy fluctuations' impact on the disaggregated level of renewable energy generation in the G7 countries. According to the empirical findings, fiscal expansion plays a significant positive role in renewable energy generation. At the same time, the G7 countries expansionary monetary policy indicates a negative reaction to their investments in renewable energy generation. The findings suggest a similar response tendency at the disaggregated levels of energy generation. On the other hand, the causal test found unidirectional causality from renewable energy to G7 fiscal and monetary policy indicators. However, there is an international benchmark related to the FIT scheme which is explained in the following description:

- The determination of FIT requires limitations, including RE technology type, large generating capacity, resource quality, and generator location.
- The duration of the PPA generally has a limit of 15–20 years based on generator type.
- FIT is made is to support the increase in NRE, especially RE generators with low capacity, such that changes will be made to regulations when objectives are met.
- Several financing schemes are available in which funds are taken from the government as incentives or from consumers as electricity users.

Furthermore, it can be explained that each country's policies will be determined by the renewable energy targets set. First, in order to meet the target for total clean, renewable, and zero-emission energy needs, renewable energy sources must be expanded and upgraded, as well as their capacity increased, so that sales tax incentives and RE access policies can be implemented. Second, the RPS policy can be implemented to build and improve energy efficiency, distribute smart power grids, and ensure affordable access to electricity. Finally, grant/loan policies or sales tax incentives can meet various daily needs, including renewable energy utilization in industry, the household sector, and vehicles.

6. Conclusions

This study evaluated and compared the scenario models of independent power plant tariff incentives related to RE in Indonesia and other developing and developed countries. This study showed that the price adjustment model (performed annually by the government) applied in East Asia is more suitable for application in Indonesia than the policies applied in other regions. Several schemes exist in which funds are taken from the government as incentives or consumers as electricity users. For the price adjustment model to be accepted by investors and not harm the industry as experienced by the solar PV industry in China, in Indonesia, policy discussion must be carried out in stages and involve all stakeholders. The adjustment of FIT rates is also a common practice in some countries. Annual tariff adjustments, such as those implemented by the Chinese government, can be used as a reference by the Indonesian government. FIT arrangements must be accompanied by strong compensation scheme arrangements. If FITs are controlled in the provisions in the body of the Presidential Regulation NRE, compensation and implementation schemes should preferably be regulated as well. Furthermore, it can be concluded that Indonesia has a similar energy policy to other developing and developed countries. This is due to Indonesia's vast renewable energy potential and targets that adhere to international benchmarks, resulting in diverse energy incentive policies in Indonesia.

Author Contributions: Conceptualization, E.S., J.S. and M.A.M.; methodology, J.S., A.D.N. and M.A.M.; validation, E.S., J.S. and M.A.M.; formal analysis, E.S., J.S., A.D.N., W.H.H. and M.A.M.; investigation, E.S. and J.S.; resources, E.S., J.S., A.D.N. and M.A.M.; data curation, E.S., J.S., W.H.H. and M.A.M.; writing—original draft preparation, E.S., J.S., A.D.N., W.H.H. and M.A.M.; writing—review and editing, E.S., J.S., A.D.N., W.H.H. and M.A.M.; visualization, J.S.; supervision, J.S. and M.A.M.; project administration, J.S.; funding acquisition, E.S., J.S., A.D.N. and M.A.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

Abbreviations

FIT	Feed in Tariff
PV	Photovoltaic
NRE	New and renewable energy
RE	Renewable energy
LCOE	Levelized Cost of Electricity
R&D	Research and Development
RD&D	Research, Development, and Demonstration
RPS	Renewable Portfolio Standard
kWh	Kilowatt-hours
EEG	Erneuerbare-Energien-Gesetz (German Renewable Energy Sources Act)
PPA	Power Purchase Agreement
GHG	Greenhouse Gas
FIP	Feed in Premium
SEDA	Sustainable Energy Development Authority
BPP	Biaya Pokok Penyediaan (Cost of Electricity Supply)
MW	Mega Watt
TWh	Terawatt-hours
Mt	Metric ton
VAT	Value Added Tax
VEPF	Vietnam Environmental Protection Fund
PLTB	Pembangkit Listrik Tenaga Bayu (Wind Power Plant)
PLTA	Pembangkit Listrik Tenaga Air (Hydroelectric Power Plant)
PT	Perseroan Terbatas (Limited Liability Company/Incorporated)
PLN	Perusahaan Listrik Negara (State Electricity Company of Indonesia)
IPP	Independent Power Producer
Pepres	Peraturan Presiden (Presidential Decree)

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