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Striving for Energy Security: South Korea's Internal and External Energy Policy After the Fukushima Tragedy

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Abstract

This paper analyzes South Korea's energy policy after the Fukushima disaster. The policy is seen from two dimensions, namely internal policies and external policies. The variable used in viewing the policy is through the framework described by Duffield. According to Duffield, internal policy responses can be seen from emergency preparations and reducing dependencies on foreign energy sources. In contrast, external policy response can be seen through policy toward energy-producing and transit countries, also other energy-consuming and importing countries. This research is qualitative with descriptive analytics. The study found that South Korea took several energy policies related to its domestic politics to reduce its dependence on energy imports. At the same time, for the external responses, South Korea intends to diversify its cooperation with the energy-exporting countries and continues to encourage international cooperation among the importing countries.

Keywords:
energy policy, South Korea, nuclear allergy, energy security

1. Introduction

This research focuses on South Korea as one of the Asian countries with a high level of energy consumption but still relies on energy imports. According to the South Korea Ministry of Foreign Affairs, The Republic of Korea is the world's 8th largest energy consumer. The country imports almost 93.5% of its energy and natural resources consumption. In 2018, Korea spent USD 1,459 billion on importing energy and resources, equivalent to nearly 27.3% of its total amount of imports. Furthermore, Korea is highly dependent on specific regions for its imports of energy and resources, including oil and natural gas, which adds to its vulnerability in its energy security. In the case of oil, Korea imports approximately 73.5% of its oil consumption solely from the Middle East (Ministry of Foreign Affairs Republic of Korea [MOFA], 2022). In addition, on the report of the International Energy Agency, during 2000-18, Korea's total final consumption (TFC) increased by 43% while its economy expressed as a gross domestic product (GDP) in purchasing power parity (PPP) doubled, resulting in a 25% decline in energy intensity (TFC/GDP) (International Energy Agency [IEA], 2020). So, it can be seen that this research lies in how countries in the East Asian region are trying to fulfil their energy security strategies, especially South Korea. Due to the geography, the countries in East Asia are not sufficiently advantaged as a region with abundant energy sources. Specifically, the barriers for South Korea are complicated geographical conditions and sometimes extreme seasons (Ryu, 2015).

South Korea's dependence on energy imports indicates that the stability of its energy will depend on the regulation, distribution, and dynamics of the global order in the energy market. This will create uncertainty and insecurity in South Korea's domestic energy supply because the global order for energy

is vulnerable to conflicts and interests. With population growth and a significant increase in energy demand, especially in East Asian countries, governments must prepare various ways to meet their energy supply needs. One of these efforts is to utilize alternative energy sources to reduce dependence on energy imports from foreign countries. One of the policies of the South Korean government that focuses on overcoming the dependence on fossil energy is the transformation of renewable energy. South Korea is trying to find an alternative by providing a solution for its country to build nuclear facilities to reduce its dependence on external energy. In addition, this supply-side-oriented strategy has also led to the implementation of large-scale renewable energy projects, which is in line with South Korea's vision for energy diversification (Poirier, 2011).

Relying on South Korea's energy security stability through nuclear is one of the right decisions. Judging from the success of developing nuclear technology, South Korea can build a Nuclear Power Plant and contribute to the stability of energy security for South Korea, especially for electricity. Another thing that proves South Korea's success in nuclear energy is seen in 2009. South Korea, led by Korea Electric Power Corp. (KEPCO), successfully signed a contract worth USD 18.6 billion with the United Arab Emirates (UAE) related to selling nuclear reactors. In plans, South Korea is trying to help the UAE build nuclear reactors in 2017. This proves that South Korea has changed from an importing country of nuclear technology to be one of the countries that export nuclear technology (Hong, 2011).

After the Fukushima incident, the phenomenon of the 11 March 2011 earthquake in Fukushima Daiichi, Japan, caused damage. The leak of a nuclear reactor resulted in exposure to nuclear radiation for Japanese citizens and severe environmental damage, which surprised the public. Japan and other East Asia Countries, including South Korea, began to doubt and be pessimistic about the future of nuclear energy. This is evidenced by a poll conducted right after the Fukushima disaster in March 2011 by the South Korean public, revealing that 43% consider nuclear power plants risky, and 22% say it is safe. After this incident, the public and South Korean newspapers such as Hankyoreh and Kyunghhuang Shinmun, which adhered to liberalism, emphasized that nuclear has a high potential for danger and risk (Hong, 2011). The rejection of the South Korean public regarding the use of nuclear energy sources, the increasing number of anti-nuclear groups, and the news that doubts the effectiveness of the success of nuclear energy right after Fukushima in 2011 indicate the phenomenon of "nuclear allergy". So, to fulfil its energy needs and the encouragement of South Korean citizens who reject and are pessimistic about the progress and success of nuclear energy in the East Asian region after the Fukushima disaster, the South Korean government needs to restructure its policies and carry out energy transformation. This is meant by considering the contrasting negative public acceptance of the South Korean public towards the future of nuclear energy and the positive results felt by the existence of nuclear power plants which contribute to national energy stability. With the transformation of energy policy that considers three aspects, namely the security of energy supply, energy competitiveness, and environmental protection, it is hoped that South Korea can achieve energy security stability in the future (Doukas et al., 2008).

South Korea is one of the countries in East Asia that relies on its domestic energy consumption by importing energy sources from abroad. With a reasonably high consumption from the industrial sector, transportation and residential sector, South Korea needs to consider alternative energy sources that can be produced domestically. Considering the risk of dependence on energy imports is vulnerability and insecurity because it will depend on global energy conditions and be vulnerable to conflicts and interests. Therefore, South Korea chose nuclear energy as a way out of dependence on energy imports. Nuclear, being chosen as alternative energy, proves its essential role by contributing to stability, security, and energy fulfilment for South Korea. However, the Fukushima incident impacted countries around Japan, especially South Korea and gave rise to the phenomenon of "Nuclear Allergy". It takes into account the public's concerns and fears of nuclear energy and the positive side of the benefits of nuclear energy itself. So there is a need for a transformation of energy policy for South Korea so that energy security in South Korea can be realized. Considering the problem mentioned, the author justifies the research question for this paper, "What are South Korea's Energy Policies after the Fukushima Disaster?"

2. Method

The authors used a qualitative method with secondary data collection in this study. Data collection techniques were through internet-based research. Data was obtained from online scientific journals, electronic books, electronic media, and official websites of the South Korean government website such as KEA energy (Korean Energy Agency) and the official website of the IEA (International Energy Agency). The research also utilizes data from Google Scholar to find journal articles related to the topic with the keywords nuclear allergy phenomenon, South Korean energy transformation policies, South Korea energy politics, energy security, energy policy, South Korea nuclear dilemma, Korean Energy Agency Annual Report, and Korea Electricity Security Review.

For the research to be directed both at building a framework and conducting data collection and analysis, the author uses the framework described by Duffield in his book entitled "Seeking Energy Security in Europe, Japan, and the United States". According to Duffield, the state will make various efforts in response to energy insecurity. The responses can be categorized into two main categories: internal policy responses and external policy responses. For the internal policy response, the government can initiate domestic policies, namely emergency preparation (preparation for distribution and allocation plans, stockpiling strategies, ability to switch fuels) and reducing dependence on foreign energy sources (increasing domestic production, reducing consumption, promotion of changing energy sources, supporting energy research and development). External policy responses are related to the country's foreign policy by considering several points, including policies towards energy-producing countries and transit countries (ensuring access to energy supply and transit routes, also diversification of foreign energy supply and transit routes), and policies towards other energy consumption and importing countries (Duffield, 2015).

3. Results and Discussions

South Korea is one of the countries that depend on energy imports due to the insufficient availability of domestic energy sources. To reduce dependence on imports, South Korea has diversified its energy sources. Nuclear is an alternative because this energy source can be produced domestically in South Korea. For some time, nuclear had a good impact on energy sources. Unfortunately, the positive impact of using nuclear as an energy source that contributes to the domestic supply of electrical energy does not last long. The earthquake and tsunami in Fukushima Daiichi, Japan, had a reasonably substantial and negative impact on the future of nuclear power. South Korea's public rejection and doubts about nuclear have intensified in the aftermath of the disaster. Considering two positions, nuclear has a positive impact and has a significant impact on the security of the domestic electricity supply. However, on the other hand, there is a bad stigma from the public regarding the rejection of nuclear. South Korea issued several policies to maintain energy security in achieving its national energy security. South Korea's policy responses can be categorized into two response categories, namely internal policy responses and external policy responses.

Internal Policy Response

Duffield explained that for countries trying to improve their energy security, it is necessary to pay attention to the internal response, which is divided into two broad categories: preparation for the short term and long term. In the short term, it is intended for emergency measures designed to minimize costs by possible disruptions to incoming external supplies and to prepare for the country's vulnerability to foreign energy supply disruptions in the long term. So that with the existence of domestic policies, it is possible to seek the security of domestic supplies with various efforts made by the state. To explain more in-depth, Duffield describes two points, namely emergency preparation and reducing dependency on foreign energy sources (Duffield, 2015).

In the short term, it is difficult for the country to reduce the amount of energy obtained through external sources. Emergency preparation suitable for short-term plans is needed. In his writings, Duffield divides the types of emergency preparations that the state can carry out into three, namely stand-by rationing

and allocation plans, strategic stockpiles, and fuel-switching capabilities. Technically, emergency preparations that can be made for energy security are through stand-by rationing and allocation plans or preparation of energy distribution and allocation plans. In the short term, this strategy is possible for every country to do. This action is intended to limit domestic consumption. With this, the government can prioritize energy allocation more, for example, in the military sector. In addition, the government can limit the frequency of the amount of energy obtained by consumers. The choice that can be made is that the government can offer much higher prices for energy sources that are relatively scarce (Duffield, 2015).

For the short-term strategy, South Korea had Korea's Emissions Trading System (ETS) program in the energy allocation plan context in 2015. ETS is designed to regulate emission reductions in industry and power generation. The 2012 law on allocation and trade details that the ETS focuses on the scope, types of reduction targets, allocation methods, management, and operations of domestic carbon trading. Implementing the ETS program is mandatory for South Korean communities or individuals who produce annual emissions above 25,000 Mt CO_2 and South Korean companies with annual emissions above 125,000 Mt CO_2 (IEA, 2020).

In addition, through the PV Rental Business program, KEA (Korean Energy Agency) encourages independent rental services regarding installations sourced from Solar PV. This program allows service providers to offer installation, operation, maintenance, and customer services using solar PV energy without having to bear the investment burden and receive subsidies from the government. Another policy related to energy efficiency carried out by South Korea is Rational Energy Use in Public Institutions. This policy aims to increase public awareness of South Korea regarding energy efficiency. This goal is expected to be implemented by the central and local governments in rationalization steps under the law regarding the Rationalization of Energy Use and Guidelines for the Construction of Public Buildings. From the program described above regarding ETS, PV Rental Business, and Rational Energy Use in Public Institutions, it can be seen that South Korea is very committed to its domestic energy efficiency. It is hoped that there will be energy savings and that citizens are not accustomed to wasting energy (Korea Energy Agency [KEA], 2015).

Another short-term strategy that can be done is through strategic stockpiles or stockpiling strategies. The state can use the private or private sector to carry out a hoarding strategy. By providing incentives, the private sector is expected to open up opportunities to provide domestic energy reserves in the future. In this regard, South Korea is focusing on energy storage which plays a vital role in increasing the flexibility of the domestic electricity system. Switching to higher renewable energy and low-cost storage makes it possible to stockpile excess energy from solar and wind power generation to be used when the demand for energy consumption increases (IEA Join Report with KEEi, 2021).

Pumped Storage Hydro (PSH) is still the most widely used option for energy storage, accounting for more than 90% of energy storage capacity, equivalent to 160 GW in 2019. With some technology cost incentives, South Korea also creates essential opportunities for using Battery Energy Storage System (BESS), which has a more considerable capacity function and provides power system flexibility. BESS offers a fast and accurate response to transmit signals from operator systems. Its modularity allows various installation sizes compared to PSH to be still limited by the geography of the storage location that needs to be adjusted (IEA Join Report with KEEi, 2021). Korea has domestic energy storage with a total capacity of 291 MB (46.2 mcm); about 73% of the storage is in underground stockpiles, and about 27% of energy storage is above ground in tanks. South Korea's strategy of stockpiling or storing energy does not stop innovating in its development, as can be seen from the Pumped Storage Hydro (PSH) storage and the increasingly upgrading of the Battery Energy Storage System (BESS), which has a larger capacity function and provides power system flexibility. Korean energy hoarding also provides a place underground so that the capacity becomes larger (Korea National Oil Corporations [KNOC], 2011).

Duffield explained that countries must have the capacity and ability to switch to other energy reserves. The aim is not to fundamentally change the primary energy source but to ensure that domestic energy

use has alternatives in emergencies and conditions. In the case of South Korea, the government is trying not to depend on fossil fuels and is starting to look at economical and environmentally friendly energy sources. South Korea has ambitious dreams and goals in the draft 9th Basic Plan for Long-term Electricity (BPLE) and, most recently, green growth or the Green Deal. This plan includes a goal to increase the share of new and renewable energy (EBT), including biogas, landfill gas, solar PV and wind, from 7.4% to 20% by 2030 and 30–35% by 2040. In addition, this design estimates a reduction in nuclear power generation between 2020 and 2034 and a ban on coal-fired power generation. The utilization pattern of solar and wind power plants has a negative correlation because it depends on nature and seasons. It is very different from energy sources that rely on coal and nuclear, which are not dependent on the seasons. However, South Korea's utilization of solar (PV) and wind energy sources complements each other if, during the winter, when sunlight output is low, wind energy sources tend to be higher than in other seasons (IEA Join Report with KEEi, 2021).

The effort of switching or substituting energy sources by South Korea is one of the strategies for achieving domestic energy security. Jeju Island, one of South Korea's islands, has also promoted the spread of renewable energy since 2012 by setting an ambitious goal of becoming a "Carbon-Free Island" by 2030. By the end of 2019, the installed power generation capacity in Jeju was 285 MW by PV. Solar and 291 MW by the wind. South Korea's dependence on energy imports and nuclear development, which is a dilemma due to the doubts and fears of South Korean citizens after the Fukushima disaster in Japan, has made South Korea carry out a strategy to use alternative energy as another source of energy reserves. This is considered successful through South Korean programs to focus on domestic energy by utilizing solar and wind thermal energy, which is more environmentally friendly and renewable (IEA Join Report with KEEi, 2021).

Another strategy to achieve energy security is reducing dependence on foreign energy sources. For a relatively long period, the government needs to do this to stabilize the domestic supply. It can be said reducing dependence on foreign sources is not easy and full of challenges. Therefore, several basic ways the government can help dependence include increasing domestic production, reducing consumption, promoting substitution, and supporting relevant research and development (Duffield, 2015).

The first fundamental way to reduce dependence on foreign energy sources is to increase domestic production. The state can specifically form a State-Owned Enterprise, increase production in the private sector or encourage private companies to produce energy, and acquire controlling shares in a public or private company. Using this, the government can provide feedback to these sectors through tax breaks, subsidies, government grants, loans on favourable terms or access to resource-rich land. A country can also stimulate production by requiring utilities and consumers of the country itself to buy the energy produced at a specific price and in a certain quantity (Duffield, 2015).

South Korea continues to increase its energy supply. At the beginning of 2015, the supply of energy, especially renewable energy (RE) in South Korea, reached 12,839 ktoe and continued to increase to 13,293 ktoe or to reach 4.62% of the total primary energy supply at the end of 2015. South Korea is very dependent on energy imports, so to overcome this, it is necessary to increase the domestic energy supply, one of which is renewable energy. In 2015, investments were made up to KRW 797 billion to increase productivity in NRE development, total exports were USD 3,601 million, and company development was 473 in the NRE industry sector (KEA, 2017).

South Korea also has a program that can support the increase in domestic energy, especially NRE. The first is through the Financial Support Program regarding offers made by the government to issue long-term loans and low-interest rates for users and producers of NRE facilities to encourage their wide distribution (KEA, 2017). The target recipients of this program are the criteria for facility funds, namely for businesses and business owners who want to install NRE facilities. In addition, the criteria for manufacturing funds are for the private sector, such as factories that want to develop the production of EBT equipment. While the criteria for operating funds are for the private sector or factories that want to secure operating funds and funding flexibility for NRE equipment (KEA, 2015).

South Korea also has a Feed in Tariffs (FIT) program. It contains the standard set of electricity prices for RE plants. Also, it has provided the difference between standard electricity prices and SMP (System Marginal Price or electricity prices in the electricity market determined by the Korea Power Exchange) for 15–20 years in the future. South Korea needs to expand its support in various sectors to increase its domestic energy. Judging from the programs it implements through the Financial Support Program and Feed in Tariffs (FIT), it can be seen that to increase South Korea's energy production, it must also focus on the country's economy by supporting the private sector and individual finances, it can trigger the spirit of increasing energy. In addition, the FIT program or tax adjustments will make it easier for people to be open to new energy and start using it (KEA, 2015).

Reducing domestic consumption is considered essential to escape dependence on energy imports. Because foreign energy is potentially vulnerable to conflicts and interests, energy sources that can be traded freely across national borders result in uncertainty about the cost of energy sources because it is determined by the overall supply and demand in the global market. So, to increase energy security, it is crucial not only to reduce imports but also to limit the consumption of energy sources. There are two basic options; the first approach is to directly reduce domestic consumption, while the second is to use alternative energy sources. A country can easily limit consumption or imports by exploiting domestic market forces to determine the allocation and prices of resources. More generally, a country seeks to prevent overconsumption by imposing taxes. The state can use taxes to prevent producing and purchasing energy-inefficient equipment, machinery or vehicles. On the contrary, taxes or other incentives obtained by the state can be used to encourage private actors to develop more friendly alternative energy (Duffield, 2015).

For South Korea, which is highly dependent on energy imports, a domestic energy reduction strategy is indispensable for the future. Through the primary energy use plan, revised every five years since the 1990s, under the auspices of the Ministry of Trade, Industry, and Energy (MOTIE), several energy-saving measures were announced to encourage the general public to save energy voluntarily. The program of this activity is implementing an energy conservation campaign to reduce heating fuel consumption. MOTIE and the Korean Inspection Audit Board set up a task force to examine 660 public and private organizations to measure their progress in implementing voluntary energy-saving plans. The South Korean government also urged the energy industry to improve the energy efficiency of their products intensively. The goal of saving and reducing South Korea's energy consumption is achieved through a program to increase efficiency in all energy sectors. First, in the industrial sector, energy savings can be expanded through voluntary agreements or commitments, programs for energy-efficient industrial equipment, alternatives and improvements to efficient technologies. The second is through the transportation sector; energy savings are carried out by increasing the efficiency of the logistics system, expanding public transportation, and increasing the fuel economy of vehicles. Thirdly, through the residential or other commercial sectors, a program of minimum efficiency standards is carried out, which is projected to generate substantial savings (Boo, 2016).

Through the 2nd National Energy Basic Plan (2013), South Korea's orientation is committed to reducing and saving domestic energy. The basic policy directions consist of distributed building generation, harmonization and environmental safety, strengthening energy security, stable energy supply, and implementing energy policies that support the people. Under the agenda of the 2nd National Energy Basic Plan, there are four proposed policy tasks: reforming energy-related taxation, reforming energy prices, conducting information and communication technology-based demand management, and strengthening programs in various sectors (Boo, 2016).

The reforms related to taxation in the energy sector and the determination of energy prices are intended to encourage the rational use of electricity to be more efficient. The IEA (International Energy Agency) also welcomes South Korea's commitment to becoming environmentally friendly in the form of an energy taxation system, starting with the electricity sector. In 2018 the tax on gas energy will be reduced by 80%, and the tax on coal energy will be increased by 30% (IEA, 2020). In addition, South Korea has Renewable Portfolio Standards (RPS). It emphasizes regulations regarding electricity producers having

power plants in South Korea with an installed capacity of more than 500 MW must generate a minimum proportion of their power using new and renewable energy sources (KEA, 2015).

Another approach to reducing consumption is promoting the use of alternative energy sources. The potential for substitution will vary depending on how energy sources are used, such as energy sources for transportation, generating electricity or industrial performance materials. For example, the production of synthetic fuels or biofuels can be a substitute for gasoline, diesel for combustion engines, or the substitution of coal for oil. Another substitution promotion is promoting the development of new technologies that use available alternative energy sources to perform similar functions. If not imported, the state can play a direct role in developing and producing alternative energy sources through State-Owned Enterprises or provide incentives for private actors to do so. These measures include feed-in tariffs, price support, loan guarantees, tax credits, subsidies, and other instruments. Promoting changing energy sources when people are comfortable and dependent on the primary energy sources, especially conventional ones, is a sensitive matter so that the replacement of principal energy sources can be carried out. Therefore, strategic steps are needed so that the public can positively accept the promotion of energy substitution that is more friendly and renewable. South Korean President Moon Jae In, in his administration since 2017, has initiated changes to the country's energy policy by emphasizing increasing renewable energy while reducing nuclear power and coal. The South Korean government has an ambitious goal of increasing renewable energy in power generation from 5% in 2016 to 20% by 2030 while reducing the share of nuclear energy from 30% to 18% and the share of coal from 40% to 24% (Narita & Cames, 2019).

Although public acceptance of renewable energy in Korea has increased significantly since the Fukushima nuclear disaster in 2011, some people have never heard of renewable energy. This is an essential concern for the Korean government to be more aggressive in promoting positive renewable energy. Even so, in 2019, the Korea Energy Information & Culture Agency (KEIA) conducted a survey with the results that 84.2% of respondents agreed with the need for an energy transition policy to increase the share of renewable energy and not rely on nuclear energy. KEPCO, with its six power generation subsidiaries and other private domestic electricity producers, including in fulfilling the Renewable Portfolio Standards (RPS), are required to provide space for generation from renewable energy sources, especially solar and wind. With the successful promotion of substitution, South Korea received public approval for solar energy sources (PV) by 71%, followed by bioenergy at 65.2%, wind power at 63.5%, LNG at 38.8% and in the last position nuclear at 22.6 % and coal at 7.4% (Narita & Cames, 2019).

Another strategy that a country can take is to support research and development related to energy security. Directly, countries can promote the development of new technologies that use available alternative energy sources to perform functions similar to those performed by previous energy sources. Duffield also explained further that in order for the country to be free from foreign energy supply disruptions, the state could focus on; internal activities to build government laboratories for research and technology development, provide incentives to private companies, and regulate various instruments related to the development and development of energy research (Duffield, 2015).

South Korea, as a developed country, is also serious about developing research and energy development to create domestic energy security. The South Korean government recognizes the vital role of Research and Development (R&D) technology development in achieving its energy goals. It starts with the Basic Scheme for National Energy Resource Technology Development in 2006–2015, which includes promoting R&D in energy efficiency and conservation. Then it develops in the 2nd National Energy Master Plan 2014–2035, strengthening domestic technology's development (Compendium of Energy Efficiency Policies in APEC Economies, 2017).

The embodiment of South Korea's support for R&D is to improve the energy efficiency of industrial equipment and provide support for companies investing in energy efficiency. The Korea Institute of Energy Technology Evaluation and Planning (KETEP), established in December 2007, has the central vision and mission to advance R&D related to energy technology and to support MOTIE (Ministry of

Trade, Industry and Energy) in formulating energy technology policies (Compendium of Energy Efficiency Policies in APEC Economies, 2017). KETEP has several programs implemented, one of which is the first Energy Storage System (ESS) Technology Development Program. It focuses on supporting the development and commercialization of energy storage technologies by supporting the sLi-ion battery market, supporting research on types of Vanadium Redox Batteries (RFB) and other battery generation technologies. The second is the Smart Grid Program which focuses on developing practical and smart transmission and distribution technology to expand consumer acceptance of electrical facilities that increase system reliability. The third is the Energy Resource Recycling Program which focuses on recovering metal resources or recycling metal waste with a series of processes whose inputs are returned to support the process of running energy (KETEP, nd).

South Korea's economic policy strongly focuses on innovation and technological development. His commitment can be seen from the policy focus on the energy sector as reflected in the continued high spending on Research, Development and Demonstration (RD&D). The budget for RD&D, in absolute terms, always increases about three times higher than other IEA countries (IEA, 2020). In 2018, the budget spent on energy RD&D by the Ministry of Trade, Industry and Energy reached KRW 640 billion. In 2019, the South Korean government presented the 3rd Energy Master Plan, which demonstrates the shift of R&D and demonstration projects to a larger scale, including R&D investments in areas that support Korea's energy transition and strengthen industrial competitiveness, energy efficiency, renewable energy and hydrogen. The government will also expand R&D between government and public companies and encourage the private sector to be more severe in R&D in the energy sector (IEA, 2020).

External Policy Responses

Duffield has explained how a country needs to secure its domestic energy through internal policy strategies, including Emergency Preparedness and Reducing Reliance on Foreign Energy Sources. In addition to internal policies, Duffield also explained the need for countries to carry out external policy strategies to achieve energy security and no longer depend on external energy. Utilizing solely on internal policies does not require potential possibilities related to energy insecurity, so it is essential to understand external policies. According to Duffield, the external policy is a policy carried out by a country to seek diversification of other potential energy sources, other energy transit countries, and other energy importing countries. In other words, states can direct their energies and influence conditions outside their own countries. Duffield divides two broad categories related to external policy strategies: Firstly, policies directed at potential foreign energy suppliers and transit routes (Policies Toward Energy Produces and Transit Countries); secondly, policies towards other consumer countries that depend on imports (Policies Toward Other-Energy Consuming and Importing Countries) (Duffield, 2015).

In dealing with energy insecurity through external policies, the precise strategy is to focus on energy production and how to secure that energy through transit country routes. The country must carry out agreement or negotiation actions so that energy needs by suppliers can be met and arrive safely. Duffield explains this policy through two crucial points. Firstly, securing access to foreign energy supplies and reducing the risk that supplies shipped will be disrupted / Ensuring Access to Existing Energy Supplies and Transit Routes, as well as seeking to diversify potential sources from abroad by paying attention to transit routes / Diversifying Foreign Energy Supplies and Transit Routes (Duffield, 2015).

Countries need to ensure that access to energy supplies, especially from outside, will be safe and the risks of shipping between countries in transit are not disrupted. Countries strive to ensure the timely delivery of sustainable energy so that they are free from potential disruptions. This concern is based on the potential of foreign producers in the future being able to withhold the energy supply needed or divert it to other consuming countries for economic or political reasons. To address these concerns, countries may seek agreements or negotiations with suppliers for several energy sources of concern or primary concern. A more general strategy to deal with future vulnerabilities can be done by encouraging closer

political or economic relations with energy-producing countries, providing investment opportunities and access to domestic importer markets (Duffield, 2015).

To ensure domestic energy supply is guaranteed, several efforts have been made by South Korea to build cooperation with the country of origin of energy supply. One of the collaborations is between South Korea and a Middle Eastern country, Iran. Previously, South Korea also had many trade cooperation relations with countries in the Middle East, including Saudi Arabia, amounting to USD 54.02 billion and Libya reaching USD 2.177 billion (Cahyani, 2017). South Korea, in 2013, through Daewoo Engineering & Construction Co., won a USD 709 million contract to build a natural gas processing facility in Iraq's Akkas gas field (Levkowitz, 2013).

However, the cooperation carried out by South Korea with Iran is of concern. This is motivated by the proximity between Iran and North Korea, which is in contrast to South Korea, which is in an alliance with the United States. This situation does not stop South Korea from connecting and cooperating with Iran. It has been proven since 1967 that embassies have been established in each country, and the closer the two countries are to infrastructure development, both in the political and economic sectors. Iran's exports to South Korea can reach 50%, and around 2,500 SME trading partners in South Korea are owned by Iran (Observatory of Economic Complexity [OEC], 2015). Until 2015, South Korea again collaborated with Iran, which resulted in 66 Memorandums of Understanding (MOU) in economic cooperation with projects reaching 37.1 billion, 50% of which was allocated to the oil energy sector, both in investment and energy imports. To ensure the security of its energy routes is free from potential disturbances, South Korea has several strategies for utilizing the bilateral relations between the two countries. South Korea built a sea route to facilitate the delivery of Iranian oil through Iran's Kharg Island as an energy transit option and a place for oil tankers to be collected, which then passed the Persian Gulf route and were sent to South Korea (Cahyani, 2017).

In addition to building a sea route for shipping oil from Iran, South Korea is working with the United Arab Emirates (UAE) to ensure cargo ships transporting energy sources from the UAE to South Korea are free from disturbances, especially pirates and pirates. Through the Akh Unit, one South Korean troop was in charge of providing security protection in escorting cargo ships to avoid piracy. In February 2011, the South Korean Foreign Minister visited the UAE to discuss the agreement and strengthen the bilateral relationship, especially in the fight against pirates (Song, 2013).

To ensure its energy security, South Korea is also strengthening bilateral relations with supplying countries Saudi Arabia. In the era of President Park Geun Hye's administration, in 2015, President Park was involved in many proactive diplomatic meetings by visiting 17 countries and holding 43 meetings. Most of these countries were in the Middle East, such as the Gulf of Kuwait, Saudi Arabia, the United Arab Emirates, and Qatar. Since 1962, Saudi Arabia has been one of several countries in MENA (the Middle East and North Africa) that have established diplomatic relations with South Korea. As the largest crude oil supplier in South Korea, bilateral relations between the two countries are exclusively centred on energy trade. In 2013, President Park also visited Saudi Arabia's capital, Riyadh, to meet with Prince Alwaleed to discuss investment opportunities. By promoting a future-oriented growth strategy aligned with Saudi Arabia's economic diversification, President Park reiterated how the Saudi and South Korean economies complement each other by combining Saudi Arabian capital and South Korean technology (Hae, 2022).

In 2015, South Korea and Saudi Arabia planned to set up a construction company for Saudi Arabia's national car project to increase Saudi Arabia's crude oil exports to South Korea. In 2016, the creation of Saudi-Korea Vision 2030, which contains plans for political, economic, and social reforms led by Crown Prince Mohammed bin Salman. Saudi Arabia has plans to increase economic diversification, localization of national industry, socio-cultural welfare, and human resource development. During the discussion on Saudi-Korea Vision 2030, the two countries agreed to establish industrial cooperation to advance the automotive, shipbuilding, and electronics industries. Saudi Arabia's Minister of Energy, Industry and Minerals Khalif al-Falih discussed Saudi Aramco's co-financing with Hyundai Heavy Industries in joint shipbuilding. Some of the core benefits Saudi Arabia offers in the Saudi-Korea Vision

2030 agreement are security in the field of energy supply, funding from state assets, strategic gateways to access MENA (the Middle East and North Africa) countries, and large-scale markets. Meanwhile, the benefits that South Korea offers to Saudi Arabia are the exchange of expertise in manufacturing, experience and technology, and human resource training (Hae, 2022).

Since 2016, the South Korean government has also been actively involved with the Asia Super Grid initiative, a long-term project to build a transboundary power system between Northeast Asian countries. The main projects are interconnection with China at 2.4 GW and 330 km, Japan at 2.4 GW and 340 km, and Russia at 3 GW and 1,000 km (Ministry of Trade, Industry and Energy Republic of Korea [MOTIE], 2020). This cross-border interconnection is expected to increase domestic decarbonization. This energy effort and security enables the trade of electricity generated by Mongolia and Russia for consumption in China, South Korea and Japan. Interconnection has security benefits because it allows access to a more diverse energy supply and resource demand, has economic benefits with access to cheaper supply sources and can avoid the costs of building additional generation capacity and transmission lines (IEA Join Report with KEEi, 2021).

The activities carried out by South Korea in strengthening bilateral relations with Middle Eastern countries, which are indeed South Korea's energy source areas, are considered very appropriate. According to the strategy proposed by Duffield, to ensure that access to energy supplies, especially from outside, will be secure, it is necessary to establish good relations with energy-exporting countries. The risks and uncertainties surrounding energy imports cannot be reduced due to doubts about a dynamic future. So, it makes sense for the country to be able to think of other opportunities by seeking diversification of external sources of energy supply. Countries with advanced financial and industrial technology can expand the development of alternative energy supplies in several ways. It can extend financial and economic assistance directly to foreign governments or supplying countries, provide political support for the energy operations of private companies that will operate overseas, and finance exploration and development activities by private companies or government-owned entities. This can be in the form of the construction of transportation infrastructure, gas/oil pipelines and energy transit routes required (Duffield, 2015).

South Korea focuses on the direction of its cooperation with countries in the Middle East region. One of them to the United Arab Emirates (UAE). This is an option of choice so that South Korea's energy sources have many choices of state reserves to import energy. South Korea has made many economic investments with the UAE to build this bilateral relationship, with the energy sector as the primary focus. Until 13 March 2011, the South Korean government and the UAE signed a memorandum of understanding for South Korea's involvement in oil exploration. This agreement between South Korea and the UAE produces three oil fields with a value of up to 10 billion barrels of oil reserves. It has 6 million barrels of crude oil stored in Abu Dhabi specifically for South Korea's use (Song, 2013).

In terms of utilizing a strategy to diversify sources of energy supply from outside, some of the bilateral relations carried out by South Korea can serve as an illustration. This can be seen from the bilateral cooperation between South Korea and Indonesia. Indonesia, through the Indonesian Institute of Sciences and South Korea, through representatives of the Korean Institute of Science and Technology, collaborated in the development of environmentally friendly biofuels by utilizing Oil Palm Empty Fruit Bunches as a source of making second-generation bioethanol from 2011–2013. The cooperation between Indonesia and South Korea is based on the interest in switching from fossil energy to environmentally friendly alternative energy. This is supported by the similarities between the countries whose domestic energy still relies on conventional energy. In bilateral relations, the two countries are not only trying to produce other alternative energy, but this cooperation also involves the construction of a pilot plant or pilot plant, personal training who are experts in their fields directly from Korea who holds knowledge transfer lectures to Indonesian Institute of Sciences personnel, not only South Korea. Also, invest in capital financing with a budget of 20% of the total grant for Indonesia in developing this research, which can be realized through laboratory equipment to support research (Muyasaroh & et al., 2018).

South Korea's energy diversification is also done through bilateral cooperation with Qatar. As one of the countries in the Middle East region, there is no doubt about its wealth of natural resources. In this case, Qatar has abundant natural gas resources and has exported much of its natural gas (more than 75%) to East Asian countries. In South Korea, Qatar is the largest natural gas supplier, importing 35% of its total natural gas demand with the type of liquefied natural gas (LNG). For LNG transactions, the two countries have a responsible company. Qatar has RasGas LNG, a liquefied natural gas producer and the second-largest LNG producer in Qatar. South Korea has KOGAS (Korea Gas Corporation), a South Korean public natural gas company founded by the government in 1983. Qatari LNG shipments to South Korea each year tended to be stable at around 10.40% and began to increase after 2011. Qatar's LNG exports reached 13 million tons or 38.59% in 2012. This increase was driven by a reduction policy factor in gas emissions so that countries are required to reduce the energy that is not environmentally friendly. Natural gas is an alternative because of the nature of natural gas, which produces little gas that is harmful to the environment (Park, 2017).

Apart from Qatar, South Korea is also diversifying its energy through bilateral relations with Russia. At first, Russia, as a country with enormous natural resources, especially oil and natural gas, started its export activities to East Asia by utilizing the Sakhalin 2 pipeline, a natural gas pipeline in Russia. The contemporary movement of Japan and Korea to promise to increase investment in Russia prompted these countries to mobilize development resources in eastern Russia through the East Siberian Pacific Ocean Pipelines (ESPO) project, an oil pipeline from East Siberia to the Pacific Ocean. In 2012, total oil exports through ESPO for South Korea reached 5%, and from the Sakhalin 2 project producing and exporting oil to South Korea reached 25.4%. In 2015, the carrying capacity of the ESPO pipeline destined for the Asia Pacific reached 600,000 bbl/d. Apart from oil, Russia also exports energy sources from Liquefied Natural Gas (LNG) to East Asian countries. In 2012, Russia accounted for 2.5% of China's total LNG imports, 9.5% of Japan's total LNG imports, and 6.0% of South Korea's total LNG imports (Shadrina & Bradshaw, 2013).

Relations between South Korea and Russia continue on energy cooperation. In 2017, President Moon Jae In set one of the country's policy goals: improving relations with Russia and strengthening bilateral economic cooperation through the New North Policy. This policy is part of the Northeast Asia Plus Community of Responsibility Project, which aims to build a sustainable regional cooperation system with ASEAN by grouping forces between Mexico, Indonesia, South Korea, Turkey, Argentina, India, and Northeast Asia. In his keynote address at the Eastern Economic Forum in Vladivostok in September 2017, President Moon expanded the New Northern Policy with the "Nine Bridges" initiative, which is an economic cooperation program focused on specific projects. One of these work programs is "Gas Bridges". However, Russia is not one of the leading gas exporters in South Korea. The government is still trying to diversify its gas import channels by buying more LNG from Russia. South Korea's long-term plan is to increase Russia's LNG supply, which is currently at 1.5 million tons per year. The second direction of the "Gas Bridges" project is the construction of a gas pipeline from Russia to South Korea through North Korean territory. This project is implemented through a trans-Korean gas pipeline connection with a length of approximately 11.00 km to the end point of the Sakhalin-Khabarovsk-Vladivostok gas transmission system (Voloshchak, 2019).

South Korea is also focusing on developing environmentally friendly and renewable alternative energy for the diversity of domestic energy sources. One of the programs carried out by South Korea is Korea International Renewable Energy Conference (KIREC) in 2019. The KIREC program is an event organized by the South Korean government for three days, 23–25 October 2019 and was attended by ministers, government representatives, the private sector, the general public or civil, academic, industrial and international organizations from 108 countries and gathered in Seoul for a renewable energy conference. This conference focuses on how the world is increasing renewable energy in its mission to reduce global warming. The framework that needs to be done to increase renewable energy on a large scale at the regional, local and national levels is one of them, setting policies to expand the absorption of renewable energy on a large scale. Broadly integrate energy efficiency measures at all levels of government by encouraging public or private partnerships and forming coalitions with Non-Governmental Organizations (NGOs). In addition, it is necessary to strengthen existing initiatives to

link energy, climate, and sustainable development to create global energy balance and efficiency. KIREC is an event that has succeeded in becoming an important milestone in achieving the Paris Agreement commitments and strengthening partnerships with networks between developing and developed countries (Korea International Renewable Energy Conference [KIREC], 2019). In addition to focusing on oil imports, South Korea needs to consider the diversity of energy sources. As explained above, South Korea is trying not only to depend on oil but also to be open to biofuels, natural gas and alternative renewable energy by strengthening bilateral relations with many energy-supplying countries.

Policies directed at energy-producing and transit countries effectively promote the security of supply from foreign energy. However, uncertainty in energy insecurity leads to other possibilities for cooperating with other consumers and countries dependent on energy imports. Cooperation efforts between energy-importing countries can prepare and coordinate the implementation of emergency response to foreign energy supply disruptions together, develop means to reduce the level of imported energy consumption and switch to alternative energy sources, negotiate with energy-producing countries, and can arrange interventions. The military together so that the security of foreign energy supplies is maintained. This strategy is more effective if it is carried out collectively with countries facing similar energy security risks (Duffield, 2015).

For South Korea, this strategy is highly pursued and is reflected in several programs, one of which is implemented by the Korean Energy Agency (KEA). Together with The ASEAN Center for Energy (ACE), KEA held a workshop to improve Energy Efficiency and Conservation (EE & C), focusing on the industrial and transportation sectors. This activity is carried out for two days, 28–29 June 2021, in the 6th ASEAN Energy Outlook. The industrial and transportation sectors are predicted to have the most significant opportunities to reduce energy demand, with 41.2% and 37.1% in 2040. This program is under the auspices of the ASEAN+3 mitigation carried out by ACE and KEA, intending to be a platform for exchanging knowledge and sharing experiences on the policy and regulatory framework (EE & C) for ASEAN member states to reduce greenhouse gases (GHG) and hope to achieve the target, energy reduction by 2025 by 32%. On the first day, KEA representative Park Jung-Phi explained the Energy Efficiency Target Scheme (EETS), one of the Republic of Korea's steps in EE&C to reduce gas emissions through substantial energy efficiency in the industrial sector. EETS provides incentives for energy businesses, including active investment in energy efficiency with a voluntary 5-year scheme. The second day of the workshop focused on EE & C policies and measures in the transportation sector. KEA highlights various policies to promote environmentally friendly vehicles, such as subsidies and incentives for purchasing Electric Vehicles (EVs), including building connections with the involvement of private actors (ASEAN Center for Energy, 2021).

South Korea plays a significant role in the global Green Growth Institute (GGGI). The South Korean government is trying to spread the green growth agenda in the global community. The Korean government always supports new members and contributes to every activity carried out by GGGI, such as on critical diplomatic occasions, international conferences, bilateral meetings and other international organization activities (United Nations Industrial Development Organization [UNIDO], 2015). In addition, South Korea also conducted bilateral relations with Denmark in 2011 to discuss green economic growth, which was carried out in Seoul in October of the same year (Tajuddin, 2018).

South Korea is also cooperating with the European Union on climate change. South Korea and the European Union reaffirmed their commitment to work together to tackle global warming and agreed to develop new, renewable, sustainable, and innovative energy. The new energy sources in question focus on biofuels, biomass, wind energy, solar or thermal, and hydropower energy. Some of the actions pursued in this collaboration are advocating the efficient use of resources in each country, sharing expertise in trade schemes, increasing public and private sector financing instruments, collaborating in low-carbon technology research, and exchanging expertise in monitoring and analyzing gas effects. Carbon emissions, as well as supporting mitigation and adaptation actions for developing countries. In July 2016, the European Union launched a cooperation project worth EUR 3.5 million to support the Korea Emissions Trading Scheme (K-ETS). This project is an EU action to support climate change countermeasures in South Korea and runs from January 2018 to December 2020. In 2018, the European

Union and South Korea also formed a working group on energy, environment and climate change to discuss how to support South Korea's green growth (European Union, 2021).

Cooperation between countries in the East Asian region has been connected for a long time, especially between the three countries, China, Japan, and South Korea. This cooperation has its roots in 1999 under the auspices of ASEAN+3. Then, in 2011, it established an intergovernmental Trilateral Cooperation Secretariat (TCS). It aims to provide administrative services to the three governments (Zhang, 2016). The Trilateral Cooperation Secretariat (TCS) has held a high-level forum with the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). On 29 November, they discussed various policy practices and explored collaboration between China, Japan, and South Korea on strategic issues to achieve carbon neutrality. Reflects on the commitments of China, Japan, and South Korea to achieve net zero emissions developed by the three countries and broadly draws concrete ideas about future collaboration and multilateral cooperation inside and outside East Asia. The forum session also discussed a theme that focuses on the energy sector's transition to zero gas emissions. Together these three countries are innovators in technology for renewable energy and a cleaner industry. The mission of the three countries through this forum is to strengthen the role of the three countries in leading global action by supporting other countries, collaborating in innovation and applying low-carbon green technologies (Trilateral Cooperation Secretariat [TCS], 2019).

On 7 December 2021, a virtual 22nd Tripartite Environment Ministers Meeting (TEMM-22) was held, which was attended by the Minister of the Environment of the Republic of Korea, Han Jeoung-ae, Minister of Ecology and Environment of the People's Republic of China Huang Runqiu, Minister of the Environment of Japan Yamaguchi Tsuyoshi. This meeting is an agenda for the three ministers to exchange views on progress and environmental policies, global and regional environmental issues, and eight priority areas of the Tripartite Joint Action Plan (TJAP) 2021–2025. The eight priority areas of TJAP are (1) Air Quality improvement, (2) 3R/Circular Economy/Zero Waste City, (3) Marine and Water Environment Management, (4) Climate Change, (5) Biodiversity, (6) Chemical Management and Environmental Emergency Response, (7) Transition to Green Economy, (8) Environmental Education, Public Awareness and Engagement. The ministers shared the latest advances in environmental policy in each country. Minister Han presented "Korea's Journey towards Green Future", Minister Huang presented "Adhere to the Path of Green and Low-carbon Development, Build a Clean and Beautiful Homeland", and Minister Yamaguchi presented "Review and Outlook of Japanese Environmental Policies". This sharing is intended so that the three countries can share their views on efforts to contribute to achieving sustainable development in East Asia, as well as solving national, regional and global environmental problems (TCS, 2019). South Korea's programs and meetings with neighbouring countries in the TCS reflect South Korea's efforts always to be connected with other East Asian countries that have similarities in terms of geography, environment, and energy security. This form of cooperation can bring up programs with one vision and mission.

In addition to ensuring cooperative relations with energy-exporting countries, countries also need to build cooperative alliances with countries with the same energy sector problems. As in South Korea, which cooperates with Indonesia under the auspices of ASEAN+3, the GGGI organization, together with Southeast Asian countries, most of which have the same fate as South Korea, are relying on energy imports. South Korea's cooperation with European Union countries with the same vision and mission for climate change and the cooperation carried out by South Korea with Japan and China through the TCS (Trilateral Cooperation Secretariat) as an East Asian country that has the same geography, environment and energy security.

4. Conclusions

This study discusses the efforts of South Korea to achieve national energy security. South Korea is developing nuclear energy as an alternative energy source. It showed until the disaster in Fukushima, Japan, in 2011, which caused a nuclear reactor leak. It causes fear for the public in the East Asia Region regarding the future of nuclear energy, known as nuclear allergy. South Korea also experiences this phenomenon. The author analyzes South Korean policies after the Fukushima tragedy by using the

framework previously described by Duffield in looking at the state's policy responses internally and externally to achieve energy security. This paper concludes with South Korea's internal and external responses in dealing with energy security after the Fukushima tragedy. South Korea's internal policy response is to make emergency preparations and reduce dependence on foreign energy sources. Meanwhile, the external response is through strengthening cooperation with producers of energy sources to ensure the availability of a safe supply and cooperating with fellow importing countries to fight for common interests as importing countries. This internal and external response is realized in various policies such as the ETS program, PV Rental Business, Rational Energy Use in Public Institutions, renewable energy development programs, Financial Support Programs and Feed In Tariffs (FIT), Saudi-Korea Vision 2030, Nine Bridges: Gas Bridge, Korea International Renewable Energy Conference (KIREC), Global Green Growth Institute (GGGI), and Tripartite Joint Action Plan.

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