South Korea's Policy on Automotive Industry Hydrogen Project as a Global Decarbonization Effort

Septy Surya, Agung Purwanto, Adhiningasih Prabhawati,

Department of International Relations, Faculty of Social and Political Sciences,

University of Jember

Email: 190910101145@mail.unej.ac.id, agungpurwanto68@gmail.com,

adhining@unej.ac.id

Abstract

In January 2019, the South Korean government put forward the Hydrogen Roadmap-Economy. This policy has three main objectives, which are related to climate change issues and strengthening the energy empowerment, as well as creating a new economic growth engine for South Korea. The focus of this article is to explain the rationale of South Korea's policy decision through the automotive industry's hydrogen project to achieve carbon neutralization. This journal proves that the formation of South Korea's hydrogen economy policy is based on the rational decisions of actors in considering the pros and cons of an option according to the situation that occurs and the targets achieved.

Keywords: Energy policy, green economy, decarbonization, energy transition, rational choice

INTRODUCTION

Energy is essential and useful in supporting the needs of human life. Now in the era of industrialization, energy use has increased dramatically. Most of the energy sources still come from non-renewable fuels such as coal and oil. Non-renewable energy was formed from fossils millions of years ago. Therefore, the availability of non-renewable energy is limited. Therefore, there is a gap in the excessive use of energy with its availability. (Aditiya & Aziz, 2021, p.3). The limited availability of energy makes people try to change energy sources. In fact, obtaining energy sources can come from alternative energy sources such as water, sun, and wind.

Another phenomenon resulting from the use of non-renewable energy sources is the negative impact, such as climate change, as a result of increased GHG (Greenhouse Gas). To restore the state of the earth, an agreement has been formed by the countries. Countries are working hand in hand to find solutions to climate change problems. Through international agreements, one of which is the Paris Agreement in 2015. The goal is for countries in the world, especially greenhouse gas contributors, namely

industrialized countries, to work together to overcome climate change problems. This cooperation has largely agreed to keep the rise in the earth's temperature below 2°C so that environmental safety can be maintained. (Aditiya & Aziz, 2021, p. 3)

One example is the country of South Korea, which is one of the most developed countries in Asia. South Korea's progress is evidenced by an economy based on the industrial sector. In 1960, a structural transformation of the economic sector took place. Initially, South Korea relied more on agriculture as the driving force of the country's economy. Massively switched to the technology manufacturing sector, whose value is greater than agriculture. Until now, South Korea has shown its superiority in the export of technology, electronics, and automotive industries. This indicates that South Korea requires large energy consumption. This large energy consumption is not consistent with energy independence. South Korea has to meet its energy needs by importing energy from other countries. This can be seen from the dominance of South Korea's energy needs, 95% of which come from imported oil and coal. (Stangarone, 2021, p.510)

South Korea has been using nuclear energy as a substitute energy as its main energy supplier. But nuclear energy has several problems. One of them is security issues. With the tension between South Korea and North Korea, nuclear is a sensitive issue. This is related to the emergence of concerns about the use of nuclear energy as a weapon. The explosion of the Fukushima reactor in 2011 due to the tsunami that hit Japan also made the public question the safety of nuclear as an energy source. (Chung & Lee, 2021, p.6)

South Korea believes that hydrogen is an interesting renewable energy to be developed by the South Korean government. South Korea believes that hydrogen can be a promising new potential for the automotive green energy sector. In addition to minimizing safety risks in the use of renewable energy and low carbon emissions. (Shin, 2022, p.1) In January 2019, the South Korean government presented the Hydrogen Roadmap-Economy. In this policy formulation, hydrogen was chosen as the replacement energy source. South Korea is trying to rely on hydrogen as a transformation of the automotive industry with a broader scope. South Korea wants to take control of the automotive world with the transition of hydrogen energy as a market leader. Experts believe this is the right time to catch up with other countries in the international market. However, by October 2024, the production of hydrogen-powered cars reached 37,443 units. This is still far from the South Korean government's production target of 5.9 million units by 2040. (Embassy of Denmark in South Korea, 2022, p. 2)

Therefore, the South Korean government takes a position on the phenomena that occur. The South Korean government makes rational calculations in considering a policy

to maximize profits but with minimal risk and in accordance with the conditions that occur in the country. There are reasons why the South Korean government needs to refer to certain criteria to rationally influence the South Korean government's decision-making. It is interesting to study the South Korean government's decision-making process on the preference of hydrogen over nuclear energy as a conventional energy substitute. The identification of the South Korean government's perceptions of decision-making in the automotive industry's hydrogen project policy can be processed and interpreted in further research (Stangarone, 2021, p.511).

From the above background explanation, we can find the following problem formulation: "What are the reasons why South Korea decided on the automotive industry hydrogen project policy?

LITERATURE REVIEW

Rational Choice Theory

The author uses Rational Choice Theory as a theory in research as a concept to explain the phenomena contained in the title. Rational Choice Theory explains the reasons for the formation of South Korea's hydrogen economy policy. Rational choice can explain why the formation of an automotive industry hydrogen project policy is the result of rational calculations of the actors involved. Rational choice contains a concept with the analysis that the decision making of relevant actors is based on logical or rational considerations. The decision-making process in this theory emphasizes profit and loss or cost-benefit. Gary Becker states, "Rational decision making considers the costs and benefits of each option. (Gary Becker, 1976, "The Economic Approach to Human Behavior"). Actors need logical reasoning to maximize gains and minimize losses in order to make the best decision. Anthony Downs, an American economist and political scientist, stated, "Rational decision making will choose the option that provides the maximum benefit at the minimum cost" (Downs, A. (1957). An Economic Theory of Democracy. This theory helps to identify the greatest opportunity and the least risk. This theory states that the preference of any actor, such as the state, in making decisions is to maximize the choice of the various options available.

This theory ignores non-rational factors such as individual behavioral reflections. Behavioral considerations are emotions, feelings, and ideologies. As a result, decision making tends to be irrational. This is important to keep decisions within objective rules. The best decision is something ideal. The meaning of ideal can be interpreted differently, but it can be harmonized with the situation and conditions that occur.

METHODS

This article uses a qualitative descriptive approach by attaching descriptions in the form of written sentences using various scientific methods. The limitation of this journal is certain concentrations that aim to determine the focus. This journal focuses on South Korea's hydrogen economy policy as the object of research so that it can be linked to an understanding of rational choice theory. The author obtained secondary data through a literature review. The author uses archival literature studies that are still relevant to the discussion of this research. The data has passed the credibility requirements of a textual source about a phenomenon in the social family. The method is to discover and explore more complete and detailed information through valid sources such as scientific journals, previous research, articles, and reference books of international relations experts. The first step in collecting data is to understand the appropriate theory for the use of this research. It is then linked to the particular case study. The author collects the viewpoints of various studies from scientific articles and journals, which eventually accumulate into this research. (Sugiyono, 2016, pp. 137-146).

The standard of data validity of this research uses triangulation. The author obtains data sources by collecting data in accordance with the context, comparing data, and double-checking the sources that have passed the credibility requirements. To find differences and truth in the data. The author starts with the initial stage, which is data reduction, by selecting and classifying the feasibility of sources whose requirements must be in accordance with the research needs. Then the report is presented in the form of a description of the focus of the discussion with additional pictures, tables, and diagrams. The author finds the meeting point between the use of theory, case studies, and reference sources to become solid and form a conclusion that can be emphasized in research. (Sugiyono, 2013, p. 5)

RESULT & DISCUSSION

Decision-making on hydrogen policy in the automotive industry requires supporting reasons to occur. These reasons then form the policy formulation. According to the principle of rational choice, which is the theoretical concept in this study, that decision-making requires a logical principle. The logical principle is when decision-making is objective. The objective is a way of looking at choices that have maximum benefit and minimum risk. In rational choice, the determination of maximum benefit and minimum risk is done by choosing options. Choosing between two or more options creates a comparison that can be used as a benchmark to see the benefits and

costs. Among these options, the chosen choice is the most appropriate choice according to the conditions of the problem that arises and the objectives to be achieved.

Under the conditions that exist in South Korea, namely climate change and dependence on fossil energy imports, South Korea needs to move away from fossil energy sources. After identifying the existing problems, the South Korean government needs to set goals to be achieved by the South Korean government. The goal set by the South Korean government for the problem of climate change and dependence on fossil energy imports that occur is zero net carbon in 2050. These problems and goals are useful as a reference for decision making. As in the principle of rational choice, the choice made is the choice that is in accordance with the problem and the goal.

Therefore, there is a reason for the formation of the automotive hydrogen policy by South Korea. The reason is in accordance with the conditions that occur in South Korea, namely climate change and dependence on fossil energy imports, which then become the core of the problem. The reason is also the goals achieved by South Korea, namely zero net carbon by 2050. These reasons can be described as follows:

1. Greenhouse Gas Emission

The first reason is greenhouse gas emissions. This was discussed in the Paris Agreement in 2015. The international agreement discusses efforts to combat climate change. The effort is to keep the earth's temperature from rising by 2°C. As a member country that joined the agreement, South Korea indirectly agreed to participate in dealing with the issue. The Paris Agreement emphasizes the greening of the automotive sector, whether it operates on land, in the air, or at sea. This is because the automotive sector is one of the largest contributors to greenhouse gas emissions. The large greenhouse gas emissions come not only from vehicle exhaust but also from the manufacturing industry. Therefore, with the increasing global awareness of the high levels of greenhouse gas emissions that occur, there is pressure on South Korea to act similarly in addressing climate change. This is because South Korea, as a country, has a reputation in the international sphere, so the attitude of the South Korean government affects the world's view of South Korea.

Moreover, climate change is happening worldwide, including in South Korea. As a country, South Korea is also experiencing the direct effects of climate change. The effects of climate change that South Korea is experiencing are an increase in temperature and extreme rainfall. In a survey of South Koreans in 2020, 86% said they believe climate change is a major threat to their country. To reduce the effects of climate change, it is

necessary to address the causes of climate change. The main cause of climate change is greenhouse gas emissions, which are increasing in the current era. Therefore, the South Korean government is making efforts to reduce greenhouse gas emissions by making the automotive industry hydrogen project policy following the contents of the Paris Agreement, which suggests the greening of the automotive sector.

2. Global Hydrogen Electric Vehicle Market and Trends

The first reason is greenhouse gas emissions, which have led to a global awareness of the need to make efforts to reduce greenhouse gas emissions. One of the efforts is to replace vehicles with more environmentally friendly ones. The transition to cleaner energy is becoming a global priority along with increased environmental awareness. The increased awareness has led to an increase in the demand for eco-friendly vehicles.

Thus, the trend and global market for hydrogen electric vehicles is the second reason in shaping the hydrogen policy of the automotive industry, because the automotive industry contributes to the South Korean economy. The existence of global trends and markets for hydrogen electric vehicles makes South Korea see this as an opportunity in the automotive industry. This opportunity can be a form of competition with other countries such as the United States and Japan in the automotive industry. The significant development of hydrogen trends and markets in the automotive industry affects South Korea's policy decisions because South Korea hopes to dominate the market and become a market leader in hydrogen vehicles.

3. National Automotive Industry Support

Regarding the second reason, how global trends and markets influence decision making, the support of the national automotive industry is an important part. The advanced state of South Korea's industry convinced South Korea to decide on the automotive industry's hydrogen policy. Proof of this progress is the successful control of 10% market share in 2019.

This progress is also proven by the South Korean government with the technological innovations that South Korea has. South Korea is known worldwide as a country that has technological innovations in the form of futuristic features in vehicles. In line with the global trend and market for hydrogen electric vehicles, South Korea has the technological sophistication to electrify the production of motorized vehicles. This enthusiasm is evidenced by the statements made by automotive companies in South Korea, such as Hyundai, Kia, and SK Group, regarding the development of hydrogen vehicle technology in the future. Support for the development of hydrogen vehicle technology also comes in

the form of financial, technological, infrastructure, and research support. These positive supports later became the reason why South Korea decided on the hydrogen policy of the automotive industry.

4. Improved Energy Security

Related to the third reason, as a country with a developed automobile industry, South Korea indirectly has high energy consumption needs. This high energy consumption is not accompanied by its energy independence. As a country, South Korea has to meet its energy needs by importing from other countries. South Korea's energy dependence on imports reaches 97% of its total energy consumption. Moreover, South Korea as a country does not have any natural resources that can be used for its energy needs. This poses a threat to South Korea's energy security. Although South Korea has technological and infrastructural advantages in processing energy sources, this does not make South Korea free from energy security problems. Therefore, overcoming import dependence is important for South Korea to ensure the country's energy security. One of the efforts to increase energy security and reduce import dependency is the energy transition. Thus, increasing South Korea's energy security is a supporting reason for the automotive industry's hydrogen policy decision.

5. **South Korea's Energy Diversification**

This is related to the previous reason, which is to increase energy security. As a country that is dependent on fossil energy and has limited natural resources, South Korea is overcoming this through energy diversification. Diversification is an effort to vary the type of energy used. Countries that are heavily dependent on fuel imports typically vary the type of fuel. The goal of this effort is not to rely on one main source of energy. This is in contrast to fuel-producing countries such as the United States, China, and several European countries. South Korea is using this strategy to achieve energy security.

This energy diversification also applies to the use of vehicle fuels. Gasoline and diesel dominate the use of vehicle fuels in South Korea. To reduce the dominance of any one energy source, South Korea has added liquefied natural gas to the fuel mix, and its use has reached 10% of all vehicles in South Korea. To further diversify the types of transportation fuels, the South Korean government is intensifying the electrification of vehicle types. The point is to encourage the adoption of alternative energy vehicles. Thus, energy diversification is the reason why the South Korean government decided on the automotive industry's hydrogen policy to expand the use of new energy.

6. Advantages of Hydrogen Compared to Nuclear

As in the previous consideration of energy diversification in South Korea,

electrification, or the use of electricity as a fuel, is a new agenda. In the electrification agenda, hydrogen is the fuel of choice. Hydrogen is the focus of the new clean energy. The selection is based on certain criteria and advantages of hydrogen itself. Similarly, nuclear has not been chosen for certain reasons. Nuclear energy was not chosen as the main focus of replacement energy because of several safety issues that made its image bad in the eyes of the public. Nuclear energy has a high level of risk in its use. In addition, nuclear energy is a source of political tension between countries. This is due to the fear of using nuclear energy as a weapon.

South Korea, which has a regional conflict with North Korea, is trying to shift the use of nuclear energy by making an energy transition to hydrogen, hoping that this can reduce tensions between the two countries. Then the situation that occurred regarding climate change made the world agree on a transition to a green economy. Hydrogen is an energy source that fits the global situation, so its use is expected to increase in the future. Hydrogen as a substitute energy is also a clean energy that only produces waste pollutants in the form of water vapor. Whereas nuclear combustion produces radioactive waste. The advantages of hydrogen over nuclear energy are the reason why South Korea decided on the hydrogen policy for the automotive industry.

7. Advancement of Innovation and Technology

The next reason is South Korea's advanced innovation and technology. The advancement of a country's innovation and technology can be a reason for consideration in a policy, especially for energy transition policies. As a developed country in East Asia, South Korea has good technological innovation. This can be proven by the progress of the South Korean economy, which is dominated by automotive and electronics. Both sectors certainly require technological sophistication to be able to compete in the global market as South Korea can achieve now. South Korea's automotive and electronics sector is famous for its futuristic new features. South Korea's position as the fifth largest producer of vehicles and automotive parts in the world motivates South Korea to explore energy switching in the automotive industry. South Korea, who saw this, quickly responded to the paradigm shift in the global automotive world. South Korea is concentrating on combining energy renewal in technology and information technology. This can help South Korea in implementing the energy transition in the future. Thus, innovation and technology can influence South Korea in deciding the hydrogen policy of the automotive industry.

In accordance with the principle of rational choice, decision making emphasizes maximum gain and minimum loss. To find out the maximum gain and minimum loss,

reinforcing reasons are needed according to the problems and objectives set by the author. The description above proves that South Korea's decision-making on the hydrogen policy of the automotive industry is influenced by several supporting reasons. Thus, the hydrogen policy of the automotive industry is the most ideal decision to be implemented in South Korea for the reasons that cause the formation of the policy.

CONCLUSION

The next reason is South Korea's advanced innovation and technology. The advancement of a country's innovation and technology can be a reason for consideration in a policy, especially for energy transition policies. As a developed country in East Asia, South Korea has good technological innovation. This can be proven by the progress of the South Korean economy dominated by automotive and electronics. Both sectors certainly require technological sophistication to be able to compete in the global market as South Korea can achieve now. South Korea's automotive and electronics sector is famous for its futuristic new features. South Korea's position as the fifth largest producer of vehicles and automotive parts in the world motivates South Korea to explore energy switching in the automotive industry. South Korea who saw this quickly responded to the paradigm shift in the global automotive world. South Korea is concentrating on combining energy renewal in technology and information technology. This can help South Korea implement the energy transition in the future. Thus, innovation and technology can influence South Korea in deciding the hydrogen policy of the automotive industry. In accordance with the principle of Rational Choice decision making emphasizes maximum gain and minimum loss. To find out the maximum gain and minimum loss, reinforcing reasons are needed according to the problems and objectives set by the author. The description above proves that South Korea's decision-making on the hydrogen policy of the automotive industry is influenced by several supporting reasons. Thus, the hydrogen policy of the automotive industry is the most ideal decision to be implemented in South Korea for the reasons that cause the formation of the policy.

The first reason is the unrest caused by greenhouse gases that have led to climate change. The second reason comes from the international scope, namely the Paris Agreement, which can put pressure on the South Korean government to form an energy transition policy. The pressure comes as a form of South Korea's commitment to the global scope in dealing with climate change. Then, South Korea has a responsibility to protect the community from climate change, which has an impact on the survival of the South Korean people. This can then make the South Korean government take a stand by considering several other

supporting reasons. The second supporting reason is the trend and market for hydrogen-fueled vehicles, which can be an opportunity to compete in the automotive industry with other countries and is expected to be able to seize market dominance and become a market leader in the automotive industry. The third reason is the support of the South Korean national automotive industry for the development of hydrogen vehicle technology in the form of financial, technological, infrastructure, and research support. The fourth reason is to increase energy security. To reduce import dependence, one of the ways is to make an alternative energy transition. The fifth reason is energy diversification to avoid dependence on one main energy source and to expand the use of other energy sources, especially environmentally friendly energy sources such as hydrogen. The sixth reason is the superiority of hydrogen over nuclear energy. Nuclear energy has not been chosen as the main focus for replacement energy because of several security issues that have given it a bad image in the eyes of the public. Hydrogen as a substitute energy is a clean energy that produces only waste pollutants in the form of water vapor. The seventh and final reason is South Korea's progress in innovation and technology, which focuses on combining energy renewal in technology and information technology. This can help South Korea to realize the energy transformation in the future.

For these reasons, the hydrogen policy of the automotive industry can be formed. The policy is the chosen option because it is following the rational or logical principle of maximum benefit and minimum risk. The automotive industry hydrogen policy is formed as a solution to the problems that arise, namely the need to abandon fossil energy sources due to climate change and energy import dependence. Therefore, the automotive industry hydrogen policy is also formed as a way or effort so that the goal of zero net carbon by 2050 can be achieved.

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