Analysis on the Development of German Renewable Energy by Interdependency Theory

Yang Mei*

Hubei University, China

Abstract. In the face of climate change, it is urgent to transform the energy system. Germany has played an important role in the development of renewable energy. Hence, it is necessary to figure out why Germany makes structural change in its energy sector in order to have a better understand on the current situation and the future development of renewable energy. Adopting the theory of interdependence, this paper analyzes the motivation of Germany's energy transition. It demonstrates that Germany on the one hand endeavors to reduce its energy dependence on other countries and increase other countries' dependence on it in the field of renewable energy, on the other hand. Thereby Germany would get more advantage in international negotiation and competition. This paper reveals the principle of interdependence in energy transition, which provides a new perspective to discuss the politics of climate change.

1 The introduction to Interdependency theory itself

Interdependency theory proposed by Robert Keohane refers to the status of interplay among international actors. High dependency on others is negative for a country, at least in the fields that this country relies on others. This theory contains the interdependency of sensitivity and the interdependency of vulnerability. The interdependency of sensitivity means the sensitivity triggered by other actors' actions, such as many countries are sensitive to the prize of oil. The interdependency of vulnerability means the cost caused by changing policy because of the sensitivity. For example, both the United States and Japan are sensitive to the prize of oil in global market, but Japan is far more vulnerable than the United States since Japan highly relies on importing oil from foreign countries, while the United states has abundant oil resources at home. In other words, the cost of Japan in changing its source of energy is higher than that of the United States. If one country could reduce its interdependency and increase others' reliance on it, this country could gain more power to realize its goal and maintain the interest it seeks. Maybe it sounds like the theory of realism, but the power and interest in current international society is not equal to rule and control, they depends on the particular preference of countries.

The principle of interdependency theory could be used to explain the motivations of Germany to develop renewable energy apart from protecting environment. German energy supply highly relies on import, by developing renewable energy Germany could reduce such kind of dependency and increase its advantage in global cooperation, negotiation and competition.

2 How the development of renewable technology reduces the Interdependency of Germany

Fig.1. Energy dependency ratio of Germany between 2004 to 2016

Like what is showed by the fig.1.[1] provided by World Bank, dependency rate on energy import in Germany is experiencing slight increase in general. After 2011, this figure hasn't fallen below 60 percent. And the energy dependency in Germany is higher than the average energy dependency in Europe. Since 2004, the average energy dependency in Europe has been about 50 % [2]. And for France and UK, their energy dependency were 47.1% and 35.3 % respectively [2]. The Fig.2. which introduces the energy dependency also prove the fact that Germany has high energy dependency [3]. As the the sixth largest consumer of energy in the world [4], largest national market of electricity in Europe and the fifth largest consumer of oil in the world, Germany has strong motivation to reduce its high energy dependency on import.

* Corresponding author: 2142965103@qq.com

Fig.2. The energy dependency of European countries in 2019

In 2018, 23.7 % of the total energy consumption of Germany came from gas, oil consumption accounted for 34.3% of total energy use in this country[4]. However, Germany are seriously relies on import on both oil and natural gas like the figures provided by Fig.3.[4]. Even more than half of the coal resource in Germany depends on import.

Fig.3. The percentages of import for six energy resources in Germany

High energy dependency on import means that Germany is vulnerable when the global energy market fluctuates. In international interactions high dependency on energy could make Germany pay extra cost.

Fig.4. The construction drawing of Nord Stream 2

For instance, Nord Stream 2, a huge project led by Germany and Russia and values 9.5 billion Euros. After its completion, Russia could be able to deliver 50 billion cubic meters of nature gas to EU by Nord Stream 2 which starts at Russia and ends at Germany like what showed by Fig.4.[5]. However, the success of this project would significantly reduce the market share of the US gas exported to the EU, weaken the effect of US sanction against Russia, as well as further wean the EU from the dependency on the United States. Hence, the United States decided to take actions to interrupt Nord Stream 2. In December 20th, 2019, the US president Donald Trump signed into law the National Defense Authorization Act which included the sanction imposed on the companies involving in the construction of Nord Stream 2. According to the the sanction, the United States would take measures like travel ban and the freeze on the assets of those companies in the United States. The intervention from the United States suspended Nord Stream 2 for around 1 year.

For the completion of Nord Stream 2, the Ministry of Foreign Affairs of Germany took a stand against the sanctions from the United States, it informed those companies which might be sanctioned by the United States that ignored the threats from the United States. The example of Nord Stream 2 demonstrates that Germany has to tackle the problems caused by the international conflicts related to those countries which export energy to Germany. Since the dependency on importing energy, Germany has to risk worsening the relation with powerful countries.

For Germany, renewable energy is an ideal option. The energy imported by Germany are traditional energy such as oil, natural gas and coal, and renewable energy could substitute oil and nature gas to a large extent. By rising the percentage of renewable energy in total energy consumption, Germany could lower its energy dependency. In addition, developing renewable energy is a peaceful way to decrease energy dependency, it wouldn't bring troubles to Germany in terms of diplomacy.

In fact, renewable energy has been a considerable part in the electricity production in Germany, and the development of renewable energy in Germany is showing a obviously strong rise. As a result, more and more energy consumption in Germany comes from renewable

energy instead of traditional fossil, which also means that Germany could generate energy from domestic option. From Fig.5. we could know that renewable energy occupied nearly one third of gross electricity consumption of Germany in 2015[6]. And Fig.6. tells us that one eighth of primary energy consumption in Germany was generated by renewable energy in 2015[6].

Fig.5. The percentage of German renewable energy in gross electricity consumption

Fig.6. The percentage of German renewable energy in total energy consumption

Germany Government has set a long-term target on developing renewable energy. The share of renewable energy in final energy consumption will reach at 60% in 2050, and in this year, more than 80% of electricity consumption will be generated by renewable energy[6]. If Germany really achieve its goal on renewable development, the energy independency of Germany will be very stable.

By developing renewable energy, Germany could considerably reduce its energy dependency and as a consequence Germany could largely reduce its cost when it try to transfer its source of energy supply, energy dependency will be no longer a disadvantage of Germany in international interaction and negotiation. And the low energy dependency will also provide more options to Germany in international stage. At least, the international conflicts related to those countries which export fossil fuel to Germany at present won't impose server pressure on Germany in terms of energy security and diplomacy.

3 How the development of renewable technology enhances the advantage of Germany in international interactions

Fig.7.The percentages of five kinds energies in total energy consumption

Like what is illustrated by Fig.7.[7], in present global energy consumption, traditional fossil energy still plays a dominant role, the growth speed of Traditional energy consumption also exceeds that of renewable energy and nuclear energy. In 2018, oil accounted 34% of total primary energy consumption, which was followed by coal at 27% and natural gas at 24%. The total of nuclear, hydro power and other renewable energy was merely 15%[8].

However, traditional fossil energy is exhaustible. At current rates of production, oil will be depleted in 53 years, natural gas in 54 years and coal in 110 years[9]. And the emission of carbon dioxide and other kinds of pollution caused by the burning of fossil fuel will constantly deteriorate the environment of our world. For example, global warming-caused by the use of fossil energy, could trigger extreme climate like El Nino , La Nina and melt the glaciers of Antarctic and Arctic which lead to the global sea-level rise . Moreover, acid rain, soil pollution as well as groundwater pollution are also the consequences brought by the chemical substances emitted by the use of fossil energy.

If we can't find an alternative energy to substitute traditional fossil energy in next decades, the existence of our civilization will be severely threaten since our human beings would not have enough energy to maintain the run of modern society which is high energy-consuming, and the serious environment pollution could . Up till now, developing renewable energy is the most feasible way to reduce the dependence of modern society on fossil energy. There is no doubt that renewable energy will be increasingly important in future. If one country could achieve significant technological advantages on renewable energy, this country will get advantage in future international interactions since it is necessary in both providing energy and protecting environment.

Germany is a country who has get advantages on renewable energy. Before 2014, Germany has the largest photovoltaic installed capacity, at present the scale of photovoltaic energy in Germany is 49GW, and Germany is also the third largest country in terms of installed wind power capacity[10]. And Germany owns lots of companies who participate the research of renewable energy and get success such as Enercon, Nordex, REpower systems, Siemens. Because of these companies, Germany is innovative and successful on renewable energy in worldwide. And this sort of advantage in the

aspect of renewable energy could make Germany owns higher influence.

Fig.8. The symbol of European Emission Trading System.

Taking European Union as an example. It establishes European Emission Trading System (ETS) for reducing the consumption of fossil fuel and the relevant pollution(the Fig.8. shows the symbol of this organization). Under ETS, each member states of the European Union sets a cap on its own emissions according to the rules issued by the European Commission, identifies the industries and companies which should be included in the ETS, and allocates a certain number of emission permits-European Emission Units-to those companies.

If an enterprise can make its actual emissions less than the allocated emission permits, it can sell the remaining emission rights on the emission market to make a profit. Instead, it would have to purchase emission rights on the market or face heavy fines. According to the European Commission, companies would be fined 40 € for each extra tonne of carbon dioxide emitted during the pilot phase, and the number of fine will rise to 100 € in official phase. Thus, the EU Emissions Trading System creates an incentives for enterprises and sectors in the European Union to pursue the cheapest and feasible way to reduce emissions. With this background, Germany could gain more advantage in the European Union as it has the ability to provide the most competitive technology and equipment of renewable energy to help European enterprises to reduce their emissions. In this way, the reliance on the products of renewable energy of those European countries on Germany is formed.

In addition, for those countries who do not have abundant fossil energy resources, enough technologic strength, but own good conditions of solar energy, tide energy and other sorts of sustainable energies, Germany is one of their options in terms of getting renewable technologies and equipment to secure their energy security and sustainable development, which also means that those countries may have the dependence in the area of renewable energy on Germany if they seek cooperation with Germany in relevant issues.

In general, Germany has strong research capacity and installed capacity on renewable energy and these will be the advantage of Germany because the increasing importance of renewable in worldwide. Germany could sell equipment, provide technologic assist and send experts to those countries who intend to develop their renewable sector for guaranteeing their energy security or protecting environment, which means the reliance of those countries on Germany in terms of renewable will increase. According to the principle of interdependency theory, Germany could gain more power (or influence) on international stage through renewable energy technology.

4 Conclusion

Reducing the dependency is the on of the basic behaviour logic of country. For a country, Lower dependency on others and others high dependency on itself mean more options, decision-making power and more influence in international society. When Germany is facing the high energy dependency which make this country sensitive and vulnerable when Germany is facing the problems relevant to energy supply, it is sure that Germany would take measures to down the energy dependency. When the renewable energy is an ideal option, Germany would use renewable energy as a tool to achieve its goal. It is also quite normal that the advantage of Germany in the field of renewable energy in renewable could contribute to the expand of the global influence of Germany. When a country is facing the similar problems like Germany, it is very possible that this country may use renewable energy as a tool like Germany to down the energy dependency, especially when it has enough technologic strength. And if this country owns the advantage in the field of renewable energy, it is also quite normal that this country will use such kind of advantage to expand its global influence.

When nations use the renewable energy as a tool to realize their interests (no matter in domestic field or foreign field), the development of renewable energy could get numerous support from national level. Hence, the increase pf the scale of renewable energy could be promoted, and the percentage of renewable energy in total energy consumption could be risen. As a consequence, the pollution caused by traditional fuel could be decreased with the development of renewable energy.

References

1. <https://tradingeconomics.com/germany/energy-imports-net-percent-of-energy-use-wb-data.html>
2. EU energy dependency on rise-Energy Reporters/26.04.2018/Industry
3. <https://www.cleanenergywire.org/factsheets/germany-s-dependence-imported-fossil-fuels>
4. US Energy Information Administration."International Energy statistics". Archived from the original on 8 January 2010.

5. <https://www.gazprom.com/projects/nord-stream2/>
6. FiFth “Energy transition” Monitoring Report: The Energy of the Future:2015 Reporting Year-Summary
7. BP: Statistical Review of World Energy, Workbook(xlsx), London, 2016
8. Full report-BP:Statistical Review of World Energy 2019
9. https://www.business-standard.com/article/punditry/how-long-will-fossil-fuels-last-115092201397_1.html
10. <https://windeurope.org/wp-content/uploads/files/about-wind/statistics/WindEurope-Annual-Statistics-2018.pdf>