The Study of Energy Indicators for Measuring Vulnerability in Taiwan and Coping Strategy: An Application of WEC Framework

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Overview

Taiwan's import of energy dependence is higher than 97 percent and the ratio of energy import value over GDP is 12 percent in 2014. The higher the energy price is, the more energy cost we pay. Besides, the grid of Taiwan is isolated and implies its quiet vulnerability. However, the energy policy of Taiwan is nuclear-free and plans to increase the gas-fired plant and renewable energy instead of base load power plant. In this paper, we firstly reviewed the methods of measuring energy vulnerability, and then building-up the suitable framework of Taiwan. We also sort data from public report or database and calculate the energy vulnerability in Taiwan. The findings will be provided to the government of Taiwan for determining the sustainable energy policies.

Methods

We follow and revise the methodology of WEC (2010) and Frondel *et. al* (2013) decompose the energy vulnerability indicator of Taiwan by three sub-indicators: risk of primary energy supply (PEV), risk of infrastructure in gas and electricity, and risk of end-use energy consumption (EEV). Firstly, the risk of primary energy supply is adopting the concept of Hirschmann-Herfindahl Index and considering the country risk of energy import. The data source of country risk is sorting from OECD Country Risk Classification Report. Secondly, the sub-indicator of infrastructure risk in gas and electricity is measuring by turnover rate of nature gas, electricity mix, deviation of percent reserve margin, deviation of percent operating reserve, deviation of regional electricity demand, ratio of peak load over average load etc. Thirdly, the risk of end-use energy consumption is consist of final energy consumption mix, energy cost and energy intensity. We also adopt the way of log-transformation to normalize each indicator before calculating energy vulnerability indicator.

Result

We adopt the time series data from 1991 Q1 to 2016 Q4 to calculate the energy vulnerability indicator of Taiwan. In 1991 Q1, the energy vulnerability indicator of Taiwan is 0.79 and increase to 0.89 in 2016 Q4. This result shows that energy risk in Taiwan is toward fragile during 1991 to 2016. Besides, the risk of PEV is decreasing and the other two sub-indicators are increasing. It means that the energy supply in Taiwan is much safer than before and the risk of infrastructure and EEV are higher than before.

Conclusion

For towarding sustainable energy systems of Taiwan, we have to continue diversify energy supply source and resource. Besides, the risk of infrastructure in gas and electricity is upward. We need to build-up capacity of gas, install new power plant, especially base load power plant and enhance demand-side response measures to mitigate the pressure of electricity shortage. Finally, because energy dependence of Taiwan is higher than 97 percent, the variation of international energy price will deeply affect industry and household. We suggest our government to take aggressive energy-efficiency policies to reduce negative impact by international energy price surge.

Reference

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