**Discussion, policy implication and suggestions for future research**

*Discussion on energy resources and policies and relevant implications*

Vietnam is still in the early stages of economic development, as well as energy market reform. The Government still greatly controls the energy market due to security concerns. This causes economic inefficiency to some extent in allocating resources, as well as discouraging investment. Vietnam is also a relatively small country with limited financial capacity and many enterprises are still young and perform on a small scale; hence, investments on high-energy efficient machines and facilities are still limited since installation of the advanced technology is often costly. Also, the Government only covers 30% of investment costs for new energy-saving facilities and the funding is not higher than $0.3 million (VND 7 billion) for one enterprise. Such constraints are due to financial limitations and imposed by the Government. These limitations discourage the upgrading for large enterprises because the total costs are too costly for major businesses. Participants in the energy efficiency program are also broad and diverse across many regions and sectors, causing difficulties in obtaining adequate funding. Complex procedures also result in access limitations to access credit loans for energy saving projects. The imposition of energy efficiency and conservation policies is somewhat loose; hence, numerous enterprises still fail to fulfill the requirements stipulated by the policies. Energy markets are still highly regulated by the Government and often receive subsidies to compensate for high price increases; hence, the energy prices are relatively low compared to the prices in the international markets. This situation subsequently discourages enterprises upgrading to new and more energy-saving technologies. However, the overall energy efficiency in the country is improving though at small rates as shown in 2006–15. This is because old machines and equipment have been replaced in order to produce better final products to enhance companies’ competitiveness. It is likely due to market-driven rather than policy-driven. The perception of residents and enterprises concerning climate change has also improved since media and information technology have developed rapidly. Such development allows people to connect to the internet so that they are not only aware of environmental problems within the country but also in many other regions around the world, as well as the international efforts and actions by other countries and individuals. In addition, income levels have been improved enabling more people to access to the internet and international media channels. Vietnam has also received huge financial and capital support from international organizations and other governments, for example, grants recently from the World Bank to invest in new energy-saving technologies. Hence, the country is expected to gradually increase efficiency in energy use and supply in order to assist both residential and industrial domains. Although Vietnam has committed to reduce their emission levels according to the Paris Agreement, the Government has not had a clear pathway to achieve the targets. The Law on Environmental Protection and the related tax rates on environmental-harmful products would result in a better environment but the results are still unclear about the impact levels, particularly on the emission levels. It is still uncertain whether the energy taxes are the only policy to lower the emission levels in the country in order to achieve the committed emission targets. In addition, the regulated energy taxes are apparently in conflict with the power development plan because such a plan aims to greatly increase the electricity generation from fossil fuel resources, particularly from coal — the highest emission-intensive resource. More power generation from fossil fuel resources would result in much higher overall emission levels, which would probably negate emissions saving resulting from energy taxes. Moreover, it is still unclear whether the country will have a carbon price mechanism to lower their emission level or not. Vietnam’s emission abatement targets are also not provided on the website of Climate Action Tracker, which measures the relative sufficiency of a country’s emission targets. This evidence indicates that Vietnam’s targets are unclear and the present efforts or plans of Vietnam to contribute to the worldwide actions to tackle climate change or to achieve climate change abatement goals are uncertain and need to be clarified. Vietnam is estimated to have abundant natural resources to develop renewable power and numerous private, non-government and foreign investors have invested in renewable energy in Vietnam. However, the development of the transmission and distribution network needs to be compatible with the development of power plants to avoid financial risks for all concerned, especially investors. The current situation indicates that renewable energy, particularly solar energy, has developed intensively in some specific regions (e.g., in Tay Ninh province in the South Vietnam), causing overload of the transmission networks [104]. This may result in losses of potential high volume of electricity output, thereby discouraging future investors. In addition, the FIT policy is not stable, which is also highly risky for investors, as investment takes time and completion dates are often uncertain. Vietnam also has poor transportation infrastructure and uncertain dependence on existing technology from overseas, causing constraints in the development of renewable energy. Institutional barriers also cause major difficulties in accessing potential loan sources. In addition, lower electricity prices regulated by the Government also discourage investment in renewable energy. The National Power Master Plan Policy is also at risks achieving its targets of installed capacity and output levels because the domestic production of natural resources is not able to meet the demand due to technology and investment cost constraints. For example, exploitation of coal resources in new basins at 1,000 m depth covering in large areas, including many large cities is highly costly and probably unattainable in the immediate future. Hence, power generation is highly dependent on overseas resources (particularly coal and liquefied natural gas) and technologies, which greatly depend on the international prices and prevailing policies in supplying partner countries. Therefore, Vietnam’s power sectors may not meet their resource demands for generation activities due to higher prices or export quotas from particular countries, resulting in shortfalls in achieving the installed capacity and output levels. Due to lack of financial capacity and technologies, the country has had to strongly focus on the development of fossil fuel-fired power, which would result in a longer transition process to achieve a sustainable and clean production economy. Hence, more support from international organizations and governments regarding technology transfers, as well as financial and human support, is necessary.

There are several policy implications resulted from this review.

The Government of Vietnam may need to articulate a clear pathway to inform the energy sectors to become more market-driven, it would help to increase market liquidity, resource allocation efficiency, and even encouraging the investment environment. The pathway could be divided into multiple stages along with explicit timeframe so that investors from both domestic and international sources would see clear opportunities.

• The energy efficiency programs and policies need to be specific to particular energy industries and identical across regions of Vietnam, excluding specific cases if necessary, to facilitate the application to particular environments. The Government procedures should also be minimized to hasten the application processes.

• The power development plan needs to be revised regularly, considering updated technologies and economic conditions of the country, world situations, and particular trade partner countries so that timely supplies of fossil fuel resources are secured.

• The electricity transmission networks always need to be estimated adequately and developed in advance, prior to plant investment attraction and construction so that investors are not at risk of losing electricity outputs from their power plants. Such estimates and developments should consider the regional aspects, such as income, energy demand, and infrastructure.

• To meet the emission abatement obligations, the Government should have a clear and certain climate change policy, such as a carbon tax or emissions trade scheme, which has been adopted in many other countries. The pathway of the carbon price or emission quota should also be clear for firms to evaluate their production costs, enabling them to have appropriate development strategy. In addition, the recycling revenue mechanisms should also be comprehensively considered to minimize the economic costs of the selected climate change policy

Linking between the government, research institutes, universities, and overseas scholars and companies would also encourage facilitation to share data, knowledge and transfer new technologies and techniques. This is particularly important so that researchers will be able to access better and updated research tools, data and communication in order to have more comprehensive and effective evaluations

Nong, D., Wang, C., & Al-Amin, A. Q. (2020). *A critical review of energy resources, policies and scientific studies towards a cleaner and more sustainable economy in Vietnam.*