



Energy Policy towards Low-carbon Economy and Policy Implications for Vietnam

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Abstract

Greenhouse gas emissions from energy-related activities accounts for about 70% of the global greenhouse gas emissions which puts the energy sector at the core of efforts to combat climate change. However, the role of the energy sector extends beyond climate change mitigation. Energy policy must balance competing objectives, including sustainable economic growth, increased access to energy for poor countries and people, increased food security and improved environment. A transition to a low carbon economy will require governments to take an integrated approach to address climate change and energy issues towards a low carbon economy. In Vietnam, energy sector emitted the largest proportion of greenhouse gas emissions, accounting for around 58.5% of the total greenhouse gas emissions in Vietnam in 2013. Priorities for Vietnam towards a low carbon energy policy should be placed on improvement in energy efficiency, development of renewable energy and increase in investments in low-carbon technologies.

Keywords: climate change mitigation, energy policy, energy efficiency, low-carbon economy, renewable energy



1. Introduction

Climate change is happening regardless of significant international progress to reduce greenhouse gases emissions causing climate change. According to IPCC (2014), the global average temperature increased by 0.85°C in the period of 1880-2012. In its latest report, IPCC (2018) indicated that observed global mean surface temperature for the decade 2006–2015 was 0.87°C higher than the average over the 1850–1900 period and projected that global warming is likely to increase by 1.5°C between 2030-2052 if anthropogenic emissions continue to increase at the current rate. In addition to the increase in the global temperature, the global sea level rose 0.19m in the period of 1901-2010 (IPCC, 2014). As projected by IPCC (2018), the global mean sea level (relative to 1986–2005) will rise in a range of 0.26-0.77 m by 2100 for 1.5°C of global warming, 0.1m less than for a global warming of 2°C.

Climate change will pose significant challenges on human health, livelihoods, food security, water supply, human security, and economic growth. Climate change, therefore, challenges sustainable development of all countries due to its severe impacts on ecological systems, economic performance, and social security which requires urgent responses on a global scale for both mitigation (to reduce the level or rate of climate change) and adaptation (to reduce and manage climate change impacts).

The emission of greenhouse gases, especially CO₂ from burning fossil fuels, is considered as a major cause of global climate change. Greenhouse gas (GHG) emissions from energy-related activities (including energy production and consumption) accounts for about 70% of global greenhouse gas emissions (IEA, 2016) which puts the energy sector at the core of efforts to combat climate change. Therefore, reducing GHG emissions to mitigate climate change requires profound changes in energy production and consumption patterns of all countries in the world.

Efforts in response to climate change are transforming the way the energy sector develops. The increasing ambition of the Paris Agreement on the Climate, the first global agreement binding the responsibility of all countries in combating climate change adopted in December 2015 in Paris, France and came into effect in November 2016, is accelerating the transformation. The transition to a cleaner and more efficient energy system is a key policy goal that would be consistent with a goal to keep the global temperature rises to well below 2°C and pursue efforts to limit the global temperature increase to 1.5°C by 2100 as set out in the Paris Agreement.

In addition, the role of the energy sector extends beyond climate change mitigation. Reliable, sustainable and affordable energy supply plays a crucial role to economic activity, social development and poverty reduction in order to provide all people with access to modern energy services. Energy policy must balance competing objectives, including sustainable economic growth, increased access to energy for poor countries and people, increased food security and improved environment. This is not an easy task. In the context of climate change, it is not necessary to choose between climate change mitigation and economic growth if countries make drastic changes in energy policy to ensure climate stability while maintaining economic growth. Each



country will face the challenge of meeting climate goals while at the same time ensuring social and economic functions of the energy sector. Circumstances can vary widely across countries, depending on levels of development, resource endowments and policy priorities. A transition to a low carbon economy will require governments to take an integrated approach to address climate change and energy issues toward a low-carbon energy policy.

This paper presents an overview of energy policy towards low-carbon economy and policy implications for energy policy towards low carbon economy in Vietnam in the near future.

2. Method

2.1. Theoretical framework

Climate change means a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (United Nations, 1992). IPCC (2014) defines climate change as a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer.

The climate is changed due to two groups of causes. The changes of the nature that cause climate change include the transformation of the sun's activities, the change of earth's orbit, the change in the position and scale of the continents, the transformation of maritime currents storage and internal circulation of the atmospheric system. The increase in CO₂ emissions and other GHG emissions from human activities also contributes to the warming of the atmosphere and consequently global climate change, particularly CO₂ emitted from coal, oil, and natural gas burnings in power plants, cars, and manufacturing plants; CH₄ generated from rice cultivation, livestock waste, process of disposing of waste at landfills, mining operations and gas pipelines; NO₂ from agricultural land, animal wastes, fertilizers and agricultural chemicals.

Fossil fuels account for around 81% of the energy used in the world. Despite the increasing focus on renewable sources of energy, the share of fossil fuels in the energy mix has changed little since the 1990s (OECD, 2015). In addition to supplying energy needs, fossil fuels are also the major source of the carbon emissions that are fueling climate change. GHG emissions from energy-related activities (including energy demand and supply) accounts for about 70% of the global greenhouse gas emissions (IEA, 2016) which puts the energy sector at the core of efforts to combat climate change. Therefore, reducing GHG emissions to mitigate climate change requires profound changes in energy production and consumption patterns of all countries in the world.

Unless governments take specific actions, fossil fuels will remain the choice of humanity for energy source, contributing further to the accumulation of GHG emissions. At the policy level, on the one hand, most governments are now committed to reducing carbon emissions. But on the other hand, despite the urgent challenge to cut down carbon emissions, policies in many countries continue to favour fossil fuels in terms of preferential taxes for coal and higher import tariffs of renewable energy sources. Many governments also are doing too little to encourage investment in alternative



sources of energy (OECD, 2015). A transition to a low carbon economy will require governments to take an integrated approach to address climate change and energy issues toward a low-carbon energy policy. Reform of fossil fuel and renewable energy policies should be implemented to achieve climate and socio-economic development goals.

2.2. Data source and analysis

The study uses secondary data which were collected from a variety of sources, including reports from Vietnam's Ministry of Industry and Trade (MOIT), Vietnam's Ministry of Natural Resources and Environment (MONRE), Intergovernmental Panel on Climate Change (IPCC), books, journals, papers, and research reports of individuals and organizations related to the topic of research. Particularly, data on the global climate change and GHG emissions were collected from IPCC reports; data related to energy supply and consumption in Vietnam was gathered from MOIT reports; and data on GHG emissions from energy-related activities in Vietnam were collected from MONRE.

Desk study is used to review the literature to systematize theoretical framework on low-carbon energy policy. Statistical, descriptive and comparative methods are used to analyze energy supply-demand and GHG emissions from energy sector in Vietnam as well as existing policies on climate change mitigation and low-carbon energy development in Vietnam.

3. Results

3.1. Climate change and the challenge of the energy system

The emission of GHGs, especially CO₂ from burning fossil fuels, is considered as a major cause of global climate change. According to IPCC (2014), the total anthropogenic GHG emissions increased from 27 GtCO₂eq (in 1970) to 33 GtCO₂eq (in 1980), 38 GtCO₂eq (in 1990), 40 GtCO₂eq (in 2000) and reached 49 GtCO₂eq in 2010.

The energy-related activities include all processes of exploitation, conversion, storage, transmission, and distribution that convert primary energy sources into secondary energy sources to serve energy end users. According to IPCC (2014), of the 49 GtCO₂eq emitted in 2010, about 35% came from the energy supply. Energy sector emitted the largest proportion of GHG emissions (accounting for 25.9% in 2004 and 34.6% in 2014) (Table 1).

Table 1: Global greenhouse gas emissions by sectors in 2004 and 2010 (%)

Sectors	2004	2010
1. Energy	25,9	34,6
2. Industry	19,4	21,0
3. Forestry and land use	17,4	12,2
4. Agriculture	13,5	11,8
5. Transport	13,1	14,0



6. Building	7,9	6,4
7. Wastes	2,8	0

Source: IPCC (2007) and IPCC (2014)

GHG emissions from energy-related activities (including energy supply and demand) accounts for about 70% of global greenhouse gas emissions (IEA, 2016). Therefore, reducing GHG emissions to mitigate climate change requires fundamental changes in energy production and consumption patterns in all countries in the world.

Efforts in response to climate change are transforming the way the energy sector develops. The increasing ambition of the Paris Agreement on the Climate is accelerating the transformation. The Paris Agreement is seen as a turning point in the fight against global climate change, in which the transition to low carbon development pathways and low carbon energy systems has been broadly recognized as an inevitable trend in the near future. Although the rate of transformation is uncertain, deep reductions of GHG emissions from energy sector play a very important role.

3.2. Energy policy towards low-carbon economy

Energy sector must achieve a transition to a decarbonized, reliable and secure energy sector at reasonable costs in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. This transition has been promoted by the Paris Agreement which sets the objectives of keeping the global average temperature rise well below 2°C and pursues efforts to limit this to 1.5°C by the end of the 21st century. A key mechanism to achieve these objectives is via Nationally Determined Contributions (NDCs), which were submitted by countries under the Paris Agreement and in most cases include coverage of energy sector GHG emissions. The NDCs' aim to reduce GHG emissions and to accelerate the transition to a lower carbon energy system, coupled with rapidly declining costs and increased deployment of clean and energy-efficient technologies, will have significant implications for future energy investment flows, creating both new opportunities and risks.

Addressing climate change is a transformative agenda that requires policy action now. More countries are curbing emissions through the implementation of core climate policies, including carbon pricing and market-based instruments, regulatory intervention and targeted support to innovation in low-carbon sustainable technologies.

The potential for rapid cuts in carbon emissions is great. It can be conducted if governments act quickly in three main policy areas: strengthen carbon pricing and remove fossil fuel subsidies; remove barriers to investment in the green economy; align policies across the economy – and not just in climate-related areas – and increase transparency on climate finance flows (OECD, 2015).

Aligning policies for a low-carbon economy can contribute to a broader reform agenda for greener, more resilient and inclusive growth. Beyond avoiding the severe and irreversible impacts of a more volatile global climate, reducing CO₂ emissions through energy efficiency can increase



competitiveness while improving energy security. Low-carbon transport and energy systems will result in cleaner air, better health, and a more diversified energy supply.

Low-carbon energy policies should be focused on reducing energy intensity (determined by the amount of energy consumption per GDP dollar), increasing energy efficiency, and moving to a low-energy lifestyle (switching to low-carbon fuels for cars) and low carbon energy (such as renewable energy) (IEA, 2016).

3.3. Energy supply-demand and greenhouse gas emission from energy sector in Vietnam

3.3.1. Energy supply and demand in Vietnam

Over the past 30 years, Vietnam has achieved a remarkable development record. Economic and political reforms under Đổi Mới, launched in 1986, have spurred rapid economic growth and development and transformed Vietnam from one of the world's poorest nations to a lower middle-income country. Vietnam's economy continues to show fundamental strength, supported by robust domestic demand and export-oriented manufacturing (World Bank, 2019). Following 6.2% growth in 2016 and 6.8% growth in 2017, GDP growth accelerated to 7.08% in 2018 (GSO 2017, 2018, 2019). Vietnam's growth is projected to moderate to 6.6% in 2019 (World Bank, 2019).

The energy sector plays a significant role in promoting economic development in Vietnam. Economic growth requires secure and affordable supply of energy to all economic sectors. The energy sector must be able to attract the capital required to expand energy infrastructure and to secure the supply of energy sources in the long term while at the same time reducing negative environmental impacts and controlling greenhouse gas emissions.

Table 2: Primary energy supply in Vietnam in the period 2000-2015 (KTOE)

	2000	2005	2010	2011	2012	2013	2014	2015
Coal	4,372	8,376	14,730	15,605	15,617	17,239	19,957	24,608
Oil	7,917	12,270	17,321	16,052	15,202	14,698	17,700	19,540
Gas	1,441	4,908	8,316	7,560	8,253	8,522	9,124	9,551
Hydro	1,250	1,413	2,369	3,519	4,540	4,468	5,146	4,827
Non-commercial biomass	14,191	14,794	13,890	14,005	14,121	13,673	12,745	11,925
Electricity import		33	399	333	125	200	124	136
Total	29,171	41,794	57,025	57,075	57,857	58,801	64,797	70,588

Source: MOIT (2017)

In 2015, the total primary energy supply of Vietnam was 70,588 KTOE, of which commercial energy accounted for 75.5% and non-commercial energy occupied 24.5%. The share of noncommercial biomass energy in the total primary energy supply decreased significantly from



48.6% in 2000 to 16.9% in 2015. In the period of 2001-2015, commercial primary energy supply grew by 9.5%/year (Table 2). This growth rate was higher than the GDP growth rate during the same period, leading to the elasticity coefficient of commercial energy to GDP greater than 1 (MOIT, 2017).

The share of fossil fuels and renewable energy in primary energy supply has changed over years. The share of fossil fuel supply increased from 22% of total primary energy supply of Vietnam in 2000 (15% for coal, 27.1% for oil, and 4.9% for gas) to 76% of the total primary energy supply of Vietnam in 2015 (34.8% for coal, 27.7% for oil, and 13.5% for gas). In 2000, renewable energy contributed 52.8% of the total primary energy supply (4.2% for hydro and 48.6 for biomass), but the share dropped to 24.5% in 2015 (6.8% for hydro and 16.9% for biomass). Coal plays an important role in primary energy supply in Vietnam as the share of coal grew from 15% (in 2000) to 35% (in 2015) of the total primary energy supply (Table 2).

This trend is expected to continue far into the future as the domestic supply of hydro and biomass seems to be unable to meet the increasing demand. Power plants play a key role in domestic coal consumption, followed by cement, fertilizer and chemical sectors. The total domestic coal consumption in 2015 was about 43.8 million tons, of which the power plants consumed 23.5 million tons and the final coal consumption was 20.3 million tons (the industrial sector accounted for 87% of final coal consumption) (MOIT, 2017).

Table 3: Final energy consumption in Vietnam in the period 2010-2015 (KTOE)

	2010	2013	2014	2015
Coal	9,893	10,559	11,457	11,388
Oil products	15,723	14,971	15,592	16,978
Natural gas	493	1,460	1,458	1,001
Non-commercial biomass	13,875	13,628	12,696	12,365
Electricity	7,461	9,988	11,045	12,347
Total	47,445	50,606	52,248	54,080

Source: MONRE (2017) and MOIT (2017)

In Vietnam, in term of the structure of final energy consumption, fossil fuel consumption (coal, oil products and natural gas) accounted for 55% in 2010 and occupied 54.3% in 2015 (Table 3). In general, fossil fuel consumption still accounts for a large proportion of the energy consumption in Vietnam. The share of coal used for electricity generation will increase from 32% in 2014 to 54% in 2030, while about 60% of the coal used for electricity generation will be imported (World Bank and Ministry of Planning and Investment, 2016).

In general, Vietnam has a variety of domestic primary energy sources such as coal, oil, natural gas and hydro power which have played an important role in ensuring energy security for economic development in the past two decades. However, the energy sector in Vietnam is facing challenges, including: (i) rapid growth in energy demand, and especially rapid growth of electricity demand,



(ii) since 2015 Vietnam has become a net energy importer with a net import rate of about 5% of the total energy supply and this rate is forecasted to continue increasing; (iii) energy resources are being depleted, particularly most of the hydro resource potential for large and medium hydro power plants will be fully exploited and their current capacity will increase from nearly 18 GW to about 21.6 GW in 2020; domestic coal is currently insufficient to supply the power plants. With the coal exploitation planning, approved by the Prime Minister, coal can be exploited within 70 years; however it will still not meet the demand; oil and gas resources will be reduced and depleted in the next 60 years; (iv) requirements for minimizing environmental pollution from the energy sector are stricter in order to ensure sustainable development (MOIT, 2017).

3.3.2. Greenhouse gas emission from energy sector in Vietnam

During the period 1994-2013, the total GHG emissions (with land use, land use change, and forestry - LULUCF) in Vietnam, including CO₂, CH₄, N₂O, increased from 103.8 MtCO₂e in 1994 to 259.0 MtCO₂e in 2013 (Table 4). Emissions from energy sector went up the most rapidly, a six-fold increase, from 25.6 MtCO₂e to 151.4 MtCO₂e, due to the rapid increase in energy demand. Energy sector emitted the largest proportion of GHG emissions in Vietnam, accounting for 58.5% of total greenhouse gas emissions in Vietnam in 2013.

Table 4: GHG emissions in Vietnam in the period 1994-2013 (MtCO₂e)

Sectors	1994	2000	2010	2013
Energy	25.6	52.8	141.1	151.4
Agriculture	52.4	65.1	88.3	89.4
Industrial processes	3.8	10.0	21.2	31.7
LULUCF	19.4	15.1	-19.2	-34.2
Waste	2.6	7.9	15.4	20.6
Total	103.8	150.9	246.8	259.0

Source: MONRE (2014), MONRE (2017)

The total GHG emission from energy sector in 2013 is 151.4 MtCO₂e as presented in Table 5. Emissions from fuel combustion and fugitive emissions are 86.1% and 13.9% respectively. Emissions from energy industry contributed the largest share (28.9%). The second largest share comes from manufacturing industries and construction (26.9%), followed by transport (19.6%).

Table 5: GHG emissions in energy sector in Vietnam in 2013

Categories	Total CO ₂ e	Share (%)
1. Fuel combustion activities	130.3	86.1
1.1. Energy industry	43.7	28.9
1.2. Manufacturing industries and construction	40.8	26.9
1.3. Transport	29.7	19.6
1.4. Other sectors	15.5	10.7
2. Fugitive emissions from fuels	21.1	13.9



2.1. Solid fuels	2.3	1.5
2.2. Oil and natural gas	18.8	12.4
Total	151.4	100

Source: MONRE (2017)

The shift to fossil fuel energy in recent years has been a key reason for the increase in GHG emissions from energy sector in Vietnam. In the past decade, Vietnam has had the highest GHG emissions in the ASEAN region. The total GHG emissions and GHG emissions per capita have increased nearly 3 times in a 10 year period, while the carbon intensity per GDP increased by 48% (MOIT, 2017).

4. Discussion and Conclusion

4.1. Existing policies on climate change mitigation and low carbon energy development in Vietnam

The Government of Vietnam has made significant efforts to develop and implement national laws, strategies and action plans to accelerate low carbon pathways, green growth and sustainable development, notably the Law on Natural Disaster Prevention and Control (2013), the Law on Environmental Protection (2014), the Hydrometeorological Law (2015), the Resolution No.24/NQ-TW/2013 on climate change combat, natural resource management and environmental protection, the Resolution No.08/NQ-CP/2014 on the Action Plan to implement the Resolution No.24. In addition, efforts and initiatives on climate change response in Vietnam have been reflected in Vietnam's Agenda 21 on Sustainable Development (2004), the Second National Strategy and Plan on Disaster Risk Management and Mitigation for the period 2001-2020, National Strategy on Climate Change (2011) and National Action Plan on Climate Change for the period 2012-2020, National Strategy on Green Growth (2012) and National Action Plan on Green Growth for the period 2014-2020. Responding to climate change has also been integrated into the Socio-Economic Development Strategy for the period of 2011-2020.

Viet Nam has committed to working with the international community to combat climate change, which is reflected in a variety of national policies and specific actions that have been or are being taken to combat climate change. Viet Nam submitted Viet Nam's Intended Nationally Determined Contribution (INDC) to the UNFCCC Secretariat in 2015. Viet Nam signed the Paris Agreement on the Climate on April 22nd, 2016 and approved the Paris Agreement on November 3rd, 2016. From that time, Viet Nam's INDC has officially become its NDC. According to Viet Nam's NDC, with domestic resources, by 2030, Viet Nam will reduce GHG emissions by 8% compared to the Business as Usual (BAU) scenario (estimated at 62.65 MtCO₂e) and the 8% contribution could be increased to 25% (approximately 197.94 MtCO₂e) with international support.

The main solutions to achieve the goal of reducing GHG emissions of Viet Nam's NDC are identified as to enhance the efficiency and effectiveness of energy use, and reduce energy consumption; change the fuel structure in industry and transportation; promote effective



exploitation and increase the proportion of new and renewable energies in energy production and consumption; reduce GHG emissions through sustainable agricultural development, and improve efficiency and competitiveness in agricultural production; manage and develop sustainable forests, enhance carbon sequestration and environmental services, and conserve biodiversity associated with livelihood development and income generation for communities and people dependent on forests; improve waste management; raise public awareness and enhance international cooperation (MONRE, 2015).

Regarding the energy sector, important legal and policy foundations to help Vietnam move towards a low-carbon economy include the Electricity Law 2004 and the Law amending and supplementing some articles of the Electricity Law 2004, the Law on Energy Efficiency and Conservation 2010, the National Energy Development Strategy until 2020 with the vision to 2050, the National Target Program on Energy Efficiency and Conservation (with three phases 2006-2010, 2012-2015 and 2019-2030), and the Renewable Energy Development Strategy. The implementation of these laws and strategies is having a tremendous impact on the whole economy and leads to positive progress in the country's pathway towards a low-carbon economy.

The energy sector accounts for 58% of total GHG emissions in Vietnam and is projected to increase to 86% by 2030 (MONRE, 2017). The Ministry of Natural Resources and Environment indicated that Vietnam is in urgent need to address the issue of increasing GHG emissions from energy, because renewable energy is underdeveloped (currently accounting for about 7% of the total primary energy in 2015) while fossil fuels (coal, oil, natural gas) still account for a large proportion in the structure of energy final use (around 54% in 2015). It is estimated that electricity generated from coal will account for about 50% of electricity structure by 2030. The key solutions to achieve the goal of reducing GHG emissions in the energy sector reflected in the NDC of Vietnam are to improve energy efficiency, reduce energy consumption, change fuel structure in industry and transportation, and promote exploitation of new and renewable energy in energy production and consumption.

4.2. Policy implications for low carbon energy in Vietnam in the near future

The Vietnam's energy sector has great opportunities for a transition to a low-carbon energy, including the priority of the government on economic development in line with energy security and environmental protection; great potential for continued implementation of energy efficiency and renewable energy, especially solar and wind energy, as well as increased cooperation between international organizations and the private sector in the energy sector (MOIT, 2017).

The NDC of Vietnam under the UNFCCC with a conditional 25% reduction target in GHGs could be achieved through strengthening energy efficiency and exploiting renewable energy sources with international support. These measures could also help reduce environmental impacts from energy supply activities as well as dependence on energy import. In addition, investments in low-carbon technologies are needed to facilitate such a transition in a cost-effective manner, while also working towards other policy goals.



Energy efficiency improvement

The National Target Program on Energy Efficiency and Conservation sets the goal of savings 5-8% of the total energy consumption in Vietnam in the period 2012-2015 compared to the energy demand forecast in the national power development planning in the period 2011-2020 with the vision to 2030 equivalent to 11 million TOE to 17 million TOE in the period 2012-2015. Vietnam is currently an energy intensive economy in the region and the world. Several studies in the industrial sector as well as the building sector have revealed a considerable financially viable potential for reduction of the energy intensity by upgrading the technologies and by adopting measures for more efficient management of the resources. Untapped energy efficiency potentials have been found to be about 8.1% by 2030. The costs of GHG emission reduction from the energy savings have been found to be considerably less than the benefits of energy savings. Hence, the energy efficiency options as well as the fuel substitution opportunities can offer an economic gain while reducing GHG emissions and improving the national energy security. In order to tap this potential, the energy efficiency policy framework of Vietnam needs to be strengthened.

Renewable energy development

The renewable energy development strategy aims to encourage mobilization of all resources from the society and citizens for renewable energy development, gradually increasing the proportion of renewable energy sources in the national energy production and consumption in order to reduce dependence on fossil fuels, contributing to energy security, climate change mitigation, environmental protection and sustainable socio-economic development. The revised National Power Development Plan in the period 2011-2020 with the vision to 2030 and the Renewable Energy Development Strategy together have set out concrete directions for the development of the power sector in the coming years. More ambitious targets on reduction of CO₂ emissions as well as energy import dependence could be obtained from imposing a price on CO₂ emissions. Such measure would create the incentives for investment on additional natural gas and renewable power capacity, through which the renewable energy development goals can be achieved with low additional costs within the capability of the economy.

Investments in low-carbon technologies

In the recent years, the Government has promulgated many important policies and solutions to attract investment from the economic sector into the energy sector, through the mobilization of the state budget, and encouraging private and foreign investors to participate directly in the construction, ownership and operation of energy infrastructure. The future projects in the energy sector will continue to attract investment from the private sector with an increasing proportion. Therefore, the Government should continue to build an appropriate legal and regulatory framework to ensure the investment market competitive, attractive, encouraging application of advanced technologies to meet national standards on environmental protection and energy security. Investments in low-carbon technologies in power generation, transport, buildings and industry



(including heating and cooling) are needed to facilitate such a transition in a cost-effective manner, while also working towards other policy goals.

References

1. GSO [General Statistics Office] (2017). *Socio-economic Performance in Vietnam in 2016*. Retrieved on 4 Jul 2019 from <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=16174> [Tổng cục Thống kê (2017). Báo cáo tình hình kinh tế-xã hội Việt Nam năm 2016. truy cập ngày 4/7/2019. <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=16174>].
2. GSO (2018). *Socio-economic Performance in Vietnam in 2017*. Retrieved on 4 Jul 2019 from <http://www.gso.gov.vn/default.aspx?tabid=621&ItemID=18668>. [Tổng cục Thống kê (2017). Báo cáo tình hình kinh tế-xã hội Việt Nam năm 2017. Truy cập ngày 4/7/2019. <http://www.gso.gov.vn/default.aspx?tabid=621&ItemID=18668>].
3. GSO (2019). *Socio-economic Performance in Vietnam in 2018*. Retrieved on 1 Jul 2019 from <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19037>. [Tổng cục Thống kê (2019). Báo cáo tình hình kinh tế-xã hội Việt Nam năm 2018. Truy cập ngày 1/7/2019, <https://www.gso.gov.vn/default.aspx?tabid=621&ItemID=19037>].
4. IEA [International Energy Agency] (2016). *World Energy Outlook 2016*. OECD/IEA, Paris.
5. IPCC [Intergovernmental Panel on Climate Change] (2007). *Climate Change 2007*. An Assessment of the Intergovernmental Panel on Climate Change.
6. IPCC (2014). *Climate Change 2014*. An Assessment of the Intergovernmental Panel on Climate Change.
7. IPCC (2018). *Global Warming of 1.5°C. Summary for Policymakers*. An Assessment of the Intergovernmental Panel on Climate Change.
8. MONRE [Ministry of Natural Resources and Environment] (2014). *The First Bienial Updated Report of Vietnam to the United Nations Framework Convention on Climate Change*. Vietnam Publishing House of Natural Resources, Environment and Cartography, Hanoi.
9. MONRE (2015). *Vietnam's Nationally Determined Contribution*.
10. MONRE (2017). *The Second Bienial Updated Report of Vietnam to the United Nations Framework Convention on Climate Change*. Vietnam Publishing House of Natural Resources, Environment and Cartography, Hanoi.
11. MOIT [Ministry of Industry and Trade] (2017). *Vietnam Energy Outlook Report 2017*.
12. OECD (2015). *Three steps to a Low-carbon Economy*. Policy Brief. November 2015.
13. OECD/IEA and IRENA (2017). *Perspective for Energy Transition: Investment Needs for a Low-carbon Energy System*.
14. United Nations (1992). *United Nations Framework Convention on Climate Change*. FCCC/INFORMAL/84 GE.05-62220 (E) 200705.



15. World Bank and Ministry of Planning and Investment of Vietnam (2016). *Vietnam 2035: Toward Prosperity, Creativity, Equity, and Democracy*. Washington, DC: World Bank, from <https://openknowledge.worldbank.org/handle/10986/23724> License: CC BY 3.0 IGO.
16. World Bank (2018). *Vietnam: Mobilizing the maximum financial resources to develop the energy sector*. The World Bank Report [Ngân hàng Thế giới (2018), Việt Nam: Huy động tối đa nguồn tài chính để phát triển ngành năng lượng. Báo cáo của Ngân hàng Thế giới]
17. World Bank (2019). *Overview of Vietnam*. Retrieved on 4 Jul 2019 from <https://www.worldbank.org/en/country/vietnam/overview>.