Energy Transition Pathways for the 2030 Agenda

SDG7 Roadmap for Viet Nam

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

NEXSTEP
National Expert SDG Tool for Energy Planning

Energy Transition Pathways for the 2030 Agenda

SDG7 Roadmap for Viet Nam

Developed using the National Expert SDG7
Tool for Energy Planning (NEXSTEP)

UNITED NATIONS ESCAP
Economic and Social Commission for Asia and the Pacific

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NEXSTEP
National Expert SDG Tool for Energy Planning

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Foreword: ESCAP

Foreword: Viet Nam

Abbreviations and acronyms

BAU	business-as-usual
CBA	cost benefit analysis
CO_2	carbon dioxide
CPS	current policy scenario
EE	energy efficiency
ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
EV	electric vehicle
GDP	gross domestic product
GHG	greenhouse gas
ICS	improved cooking stove
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IRR	Internal Rate of Return
$MtCO_2$-e	million tonnes of carbon dioxide equivalent
ktoe	thousand tonnes of oil equivalent
kWh	kilowatt-hour
LCOE	Levelized Cost of Electricity
LEAP	Long-range Energy Alternatives Planning
LPG	liquified petroleum gas
MCDA	Multi-Criteria Decision Analysis
MEPS	minimum energy performance standard
MJ	megajoule
MTF	Multi-Tier Framework
MW	megawatt
MWh	megawatt-hour
NDC	nationally determined contributions
NEMO	Next Energy Modelling system for Optimization
NEXSTEP	National Expert SDG Tool for Energy Planning
OECD	Organisation for Economic Co-operation and Development
PP	power plant
RE	renewable energy
SDG	Sustainable Development Goal
TFEC	total final energy consumption
TPES	total primary energy supply
US$	United States Dollar
WHO	World Health Organization

Executive Summary

Transitioning the energy sector to achieve the 2030 Agenda for Sustainable Development and the objectives of the Paris Agreement presents a complex and difficult task for policymakers. It needs to ensure sustained economic growth as well as respond to increasing energy demand, reduce emissions, and consider and capitalize on the interlinkages between Sustainable Development Goal 7 (SDG 7) and other SDGs. To address this challenge, ESCAP has developed the National Expert SDG Tool for Energy Planning (NEXSTEP).[2] This tool enables policymakers to make informed policy decisions to support the achievement of the SDG 7 targets as well as emission reduction targets (NDCs). The initiative has been undertaken in response to the Ministerial Declaration of the Second Asian and Pacific Energy Forum (April 2018, Bangkok) and Commission Resolution 74/9, which endorsed its outcome. NEXSTEP also garnered the support of the Committee on Energy in its Second Session, with recommendations to expand the number of countries being supported by this tool.

The key objective of this SDG 7 roadmap[3] is to assist the Government of Viet Nam to develop enabling policy measures to achieve the SDG 7 targets. This roadmap contains a matrix of technological options and enabling policy measures for the Government to consider. It presents three key scenarios – current policy, SDG and coal phase-out scenarios – that have been developed using national data, and which consider existing energy policies and strategies, and reflect on other development plans. These scenarios are expected to enable the Government to make an informed decision to develop and implement a set of policies to achieve SDG 7 by 2030, together with the NDC.

A. Highlights of the roadmap

Viet Nam's access to electricity was 99 per cent in 2019 and it is assumed that universal access has already been achieved by 2021. However, universal access to clean cooking technology and fuel has been, and remains a challenge as more than a quarter of the population is still relying on polluting cooking fuels and technology. Well-planned and concerted efforts will need to be made to achieve universal access to clean cooking by 2030. Energy efficiency improvement needs to be boosted across different sectors in order to achieve a 2.1 per cent annual improvement, reducing energy intensity to 3.73 megajoules per US dollar by 2030.

Viet Nam has abundant energy resources, both fossil fuel and renewables; however, the country relies on a substantial amount of petroleum products to meet national demand, particularly in the transport sector. The country's power sector is heavily reliant on fossil fuel, and the consumption of fossil fuel is expected to grow substantially in the future. The NEXSTEP analysis has examined the potential for reduction in fossil fuel use in Viet Nam by diversifying its energy sources, such as by increasing renewable energy technologies, both in the demand and supply sides.

2 The NEXSTEP tool has been specially designed to perform analyses of the energy sector in the context of SDG 7 and NDC, with the aim that the output will provide a set of policy recommendations to achieve the SDG 7 and NDC targets.

3 This roadmap examines the current status of the national energy sector and existing policies, compares them with the SDG 7 targets, and presents different scenarios highlighting technological options and enabling policy measures for the Government to consider.

B. Achieving Viet Nam's SDG 7 and NDC targets by 2030

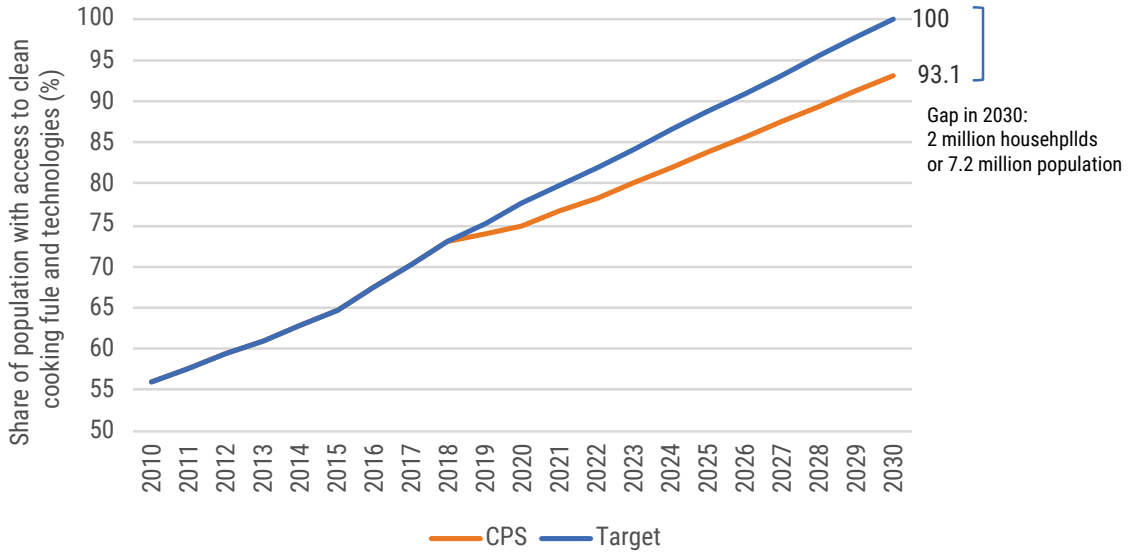
1. Universal access to electricity

In the absence of more recent information, based on the 2019 rate of 99 per cent, the roadmap assumes that the access to electricity has already been achieved.

2. Universal access to clean cooking

More than a quarter of the population in Viet Nam was still relying on polluting cooking fuel and technology in 2019, thus exposing themselves to negative health impacts. In the absence of any policy measure, it is expected that the clean cooking access will increase from the current 73.1 per cent to 93 per cent in 2030 through the current policy settings, based on the linear forecast using access rates from International Energy Agency (IEA) and the Asia Pacific Energy Portal (APEP). This will result in about 2 million households (or 7.2 million people) still relying on unclean cooking fuels and technologies, primarily by the traditional use of biomass. The NEXSTEP analysis suggests that a combination of electric cooking stoves (mostly in urban areas) and LPG cooking stoves (for rural remote areas) may be the most suitable long-term solutions for closing the remaining gap.

Figure ES 1. Access by Viet Nam to clean cooking under the CPS and SDG scenarios



3. Renewable Energy

The share of renewable energy in total final energy consumption (TFEC) was 16.7 per cent[4] in 2019. Based on current policies, the share of renewable energy is projected to increase to 18.8 per cent by 2030. The increase is due to the projected increase, both in renewable electricity and other renewable energy consumption (excluding traditional use of biomass), while TFEC is projected to increase at a slower rate. In the SDG scenario, the share of renewable energy is further improved to 21.9 per cent of

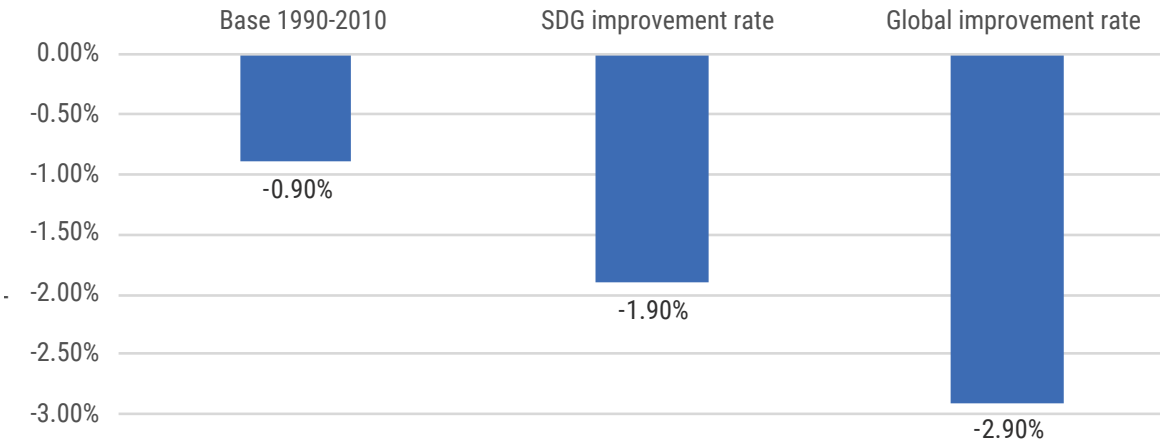
4 Excluding traditional biomass usage in residential cooking and space heating. In addition, electricity imported from India is treated as non-renewable.

TFEC in 2030. This improvement will principally be due to the increased renewable energy mix in power generation together with the adoption of electric cooking stoves and phasing out of traditional biomass usage.

4. Energy Efficiency

Viet Nam's energy intensity in 2018 was 4.8 MJ/USD$_{2011}$. Energy intensity in Viet Nam declined at an

Figure ES 2. Viet Nam energy efficiency target[5]



average annual rate of 0.9 per cent between 1990 and 2010. A doubling of the 1990-2010 improvement rate is required to achieve the SDG 7.3 target, corresponding to an average annual energy intensity decline of 1.8 per cent between 2018 and 2030. Correspondingly, to achieve the SDG 7 target. the energy intensity in 2030 should be 3.73 MJ/USD$_{2011}$SDG 7.

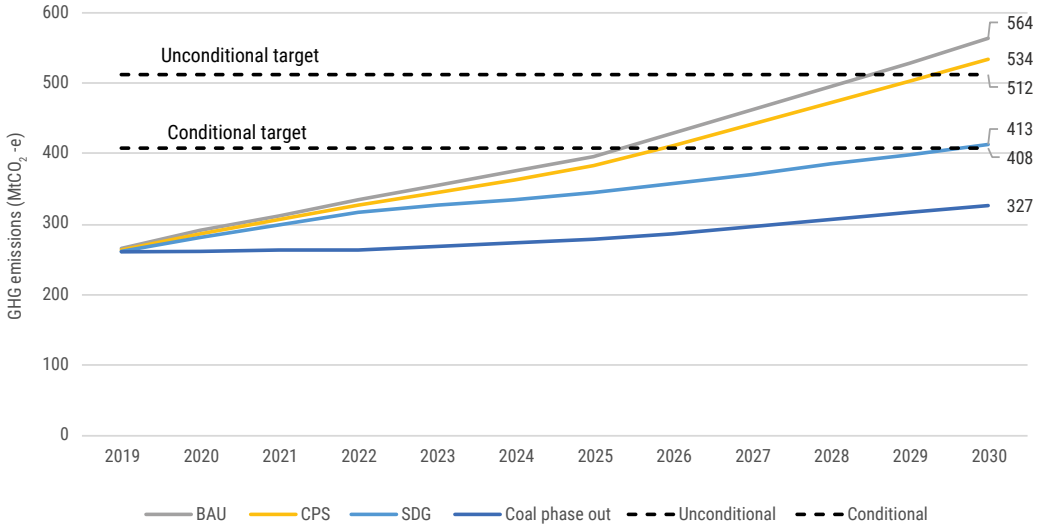
Under the current policy settings, the energy intensity is projected to drop to 4.4 MJ//USD$_{2011}$ by 2030. The energy efficiency target is exceeded in the SDG scenario with an energy intensity of 3.51 MJ// USD$_{2011}$, compared with the target of 3.73 MJ//USD$_{2011}$. This is achieved through improving energy efficiency across all sectors, e.g., through minimum energy efficiency standards (MEPS) for household appliances, increased electrification of the transport sector and mandating 20 per cent energy efficiency improvement in the industrial sector. Adoption of clean cooking technologies and phasing out of inefficient biomass-based cooking technologies will also further increase energy efficiency in the residential sector. There are ample energy savings opportunities for Viet Nam, as explored in the SDG scenario. These opportunities are discussed in later chapters of this report.

5. Nationally Determined Contribution

Viet Nam's Nationally Determined Contribution (NDC) was updated in 2020 and it commits to reducing GHG emissions for the entire economy by 9 per cent by 2030 compared to the business-as-usual (BAU) scenario using domestic resources (unconditional target). For this target, emissions are expected to be reduced by 83.9 $MtCO_2$-e by 2030. Of this rate, the reduction from the energy sector would be 51.5 $MtCO_2$-e, equivalent to a 5.5 per cent reduction compared to the BAU scenario. With international support, Viet Nam aims to achieve a 27 per cent reduction, compared to the BAU scenario (conditional target). The contribution of the energy sector to this target would be 16.7 per cent or 155.8 $MtCO_2$-e.

5 Calculated based on data from the Asia Pacific Energy Portal.

Figure ES 3. Comparison of emissions by scenarios, 2018-2030



Scenario analysis suggests that the NDC unconditional target would be comfortably achieved under the SDG scenario, and additionally will offer the Government of Viet Nam the opportunity to enhance its NDC unconditional target for the energy sector to 25 per cent. Furthermore, if the coal phase-out scenario described in this report is implemented, Viet Nam would be able to increase its NDC conditional target to 40 per cent. In COP 26, Viet Nam announced that the country would reach net zero carbon emissions by 2050; measures will include stopping deforestation by 2030 and phasing out coal-fuelled power generation by 2040.

C. Important policy directions

The roadmap sets out five key policy recommendations to help Viet Nam achieve the SDG 7 and NDC targets as well as reduce reliance on imported energy sources. The recommendations are:

(1) A combination of electric cooking stoves and LPG cooking stoves should be deployed to achieve universal access to clean cooking fuels and technologies. Further efforts are required through government policies to close the clean cooking gap. NEXSTEP analysis suggests that induction-type electric cooking stoves should be the primary focus, while LPG cooking stoves can provide access for households located in remote rural areas. The choice of these technologies is based on health benefits as well as cost effectiveness, as suggested by the annualized cost of technologies;

(2) Transport electrification strategies should be pursued to provide multi-fold benefits. Increasing the share of electric vehicles reduces the demand for oil products, hence reducing Viet Nam's reliance on imported petroleum fuels. At the same time, it can enhance energy efficiency and increase the contribution of renewable energy to the transport sector, while contributing to climate mitigation and helping to achieve the NDC target;

(3) Energy efficiency measures should be encouraged with a whole-of-economy approach. Substantial energy savings can be achieved through sustainable heating technologies in the residential and commercial sectors, while utilization of efficient household appliances reduces electricity demand. Significant energy reduction can be achieved through industrial sector best practices;

(4) Viet Nam's potential to phase out coal from the power sector by 2040. On the basis of economic, environmental and social benefits, and the country's vast, relatively untapped renewable energy resources, Viet Nam can consider increasing renewables-based electricity generation to limit the expansion of coal-fired power generation. The impact of coal-burning on public health is severe – widely known to cause various diseases and premature deaths. While there are challenges, experiences and lessons learnt from other countries suggest that an early start in planning, detailed consultations with stakeholders and developing a well-thought long-term 'just' transition plan will minimize socio-economic risks.

1. Introduction

1.1. Background

Transitioning the energy sector to achieve the 2030 Agenda for Sustainable Development and the objectives of the Paris Agreement presents a complex and difficult task for policymakers. It needs to ensure sustained economic growth, respond to increasing energy demand, reduce emissions as well as consider and capitalise on the interlinkages between SDG 7 and other SDGs. In this connection, the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) has developed the National Expert SDG Tool for Energy Planning (NEXSTEP). This tool enables policymakers to make informed policy decisions to support the achievement of the SDG 7 targets as well as emission reduction targets (NDCs). The initiative has been undertaken in response to the Ministerial Declaration of the Second Asian and Pacific Energy Forum (April 2018, Bangkok) and ESCAP Resolution 74/9 which endorsed its outcomes. NEXSTEP has also garnered the support of the Committee on Energy in its Second Session, with recommendations to expand the number of countries being supported by this tool. The ministerial declaration advises ESCAP to support its member States, upon request, in developing national SDG 7 roadmaps.

1.2. SDG 7 Targets and Indicators

SDG 7 aims to ensure access to affordable, reliable, sustainable and modern energy for all. It has three key targets, which are outlined below.

Target 7.1 – "By 2030, ensure universal access to affordable, reliable and modern energy services." Two indicators are used to measure this target: (a) the proportion of the population with access to electricity; and (b) the proportion of the population with primary reliance on clean cooking fuels and technology.

Target 7.2 – "By 2030, increase substantially the share of renewable energy in the global energy mix". This is measured by the renewable energy share in total final energy consumption (TFEC). It is calculated by dividing the consumption of energy from all renewable sources by total energy consumption. Renewable energy consumption includes consumption of energy derived from hydropower, solid biofuels (including traditional use), wind, solar, liquid biofuels, biogas, geothermal, marine and waste. Due to the inherent complexity of accurately estimating traditional use of biomass, NEXSTEP focuses entirely on modern renewables (excluding traditional use of biomass) for this target.

Target 7.3 – "By 2030, double the global rate of improvement in energy efficiency", as measured by the energy intensity of the economy. This is the ratio of the total primary energy supply (TPES) and GDP. Energy intensity is an indication of how much energy is used to produce one unit of economic output. As defined by the IEA, TPES is made up of production plus net imports, minus international marine and aviation bunkers, plus stock changes. For comparison purposes, GDP is measured in constant terms at 2011 PPP.

1.3. Nationally Determined Contribution

Nationally Determined Contributions (NDCs) represent pledges by each country to reduce national emissions, and are the stepping stones to the implementation of the Paris Agreement. Since the energy sector is the largest contributor to GHG emissions in most countries, decarbonizing energy systems should be given high priority. Key approaches to reducing emissions from the energy sector include increasing renewable energy in the generation mix and improving energy efficiency. In its revised NDC document published in 2020 (Government of Vietnam, 2020a), Viet Nam has committed to unconditionally reduce GHG emissions for the entire economy by 9 per cent by 2030, compared to the BAU scenario using domestic resources, which is expected to reduce by 83.9 $MtCO_2$-e. Of this amount, the reduction by the energy sector would be 51.5 $MtCO_2$-e, which is equivalent to a 5.5 per cent reduction compared with the BAU scenario. If international support is received, Viet Nam aims to increase its target to 27 per cent reduction, compared to the BAU scenario. The share of the energy sector in this target would be 16.7 per cent or 155.8 $MtCO_2$-e.

2. NEXSTEP methodology

The main purpose of NEXSTEP is to help in designing the type and mix of policies that would enable the achievement of the SDG 7 targets and the emission reduction targets (under NDCs) through policy analysis. However, policy analysis cannot be done without modelling energy systems to forecast/backcast energy and emissions as well as economic analysis to assess which policies or options would be economically suitable. Based on this, a three-step approach has been proposed. Each step is discussed in the following sections.

2.1. Key methodological steps

a. Energy and emissions modelling

NEXSTEP begins with the energy systems modelling in order to develop different scenarios to achieve SDG 7 by identifying potential technical options for each scenario. Each scenario contains important information, including the final energy (electricity and heat) requirement by 2030, possible generation/ supply mix, emissions and the size of the required investment. The energy and emissions modelling component use the Long-range Energy Alternatives Planning (LEAP). It is a widely used tool for energy sector modelling and creating energy and emissions scenarios. Many countries have used LEAP to develop scenarios as a basis for their Intended NDCs. shows the different steps of the methodology.

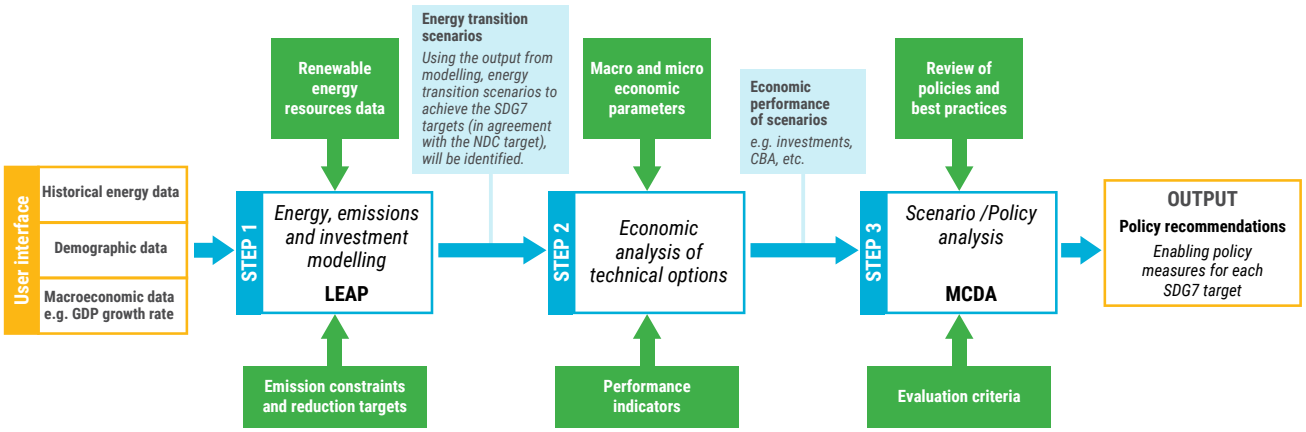
b. Economic analysis module

The energy and emissions modelling subsection selects the appropriate technologies, and the economic analysis builds on this by selecting the least cost energy supply mix for the country. The economic analysis is used to examine economic performances of individual technical options identified and to prioritize least-cost options. As such, it is important to estimate some of the key economic parameters such as net present value, internal rate of return and payback period. A ranking of selected technologies will help policymakers to identify and select economically effective projects for better allocation of resources. The economic analysis helps present several economic parameters and indicators that would be useful to policymakers in making an informed policy decision.

c. Scenario and policy analysis

Using the Multi-Criteria Decision Analysis (MCDA) tool, this prioritized list of scenarios is assessed in terms of their techno-economic and environmental dimensions to convert to a policy measure. The top-ranked scenario from the MCDA process is essentially the output of NEXSTEP, which is then used to develop policy recommendations (figure 1).

Figure 1. Different components of the NEXSTEP methodology



This tool is unique in that no other tools look at developing policy measures to achieve SDG 7. The key feature that makes it different is the backcasting approach for energy and emissions modelling. This is important when it comes to planning for SDG 7, as the targets for the final year (2030) are already given; thus the tool needs to be able to work its way backwards to the current date and identify the best possible pathway.

2.2. Scenario definitions

The LEAP modelling system is designed for scenario analysis, to enable energy specialists to model energy system evolution based on current energy policies. In the NEXSTEP model for Viet Nam, three main scenarios have been modelled: (a) a Business as Usual scenario; (b) Current Policy Scenario (CPS); (c) Sustainable Development Goal (SDG) scenario. In addition, ambitious scenario (d) has been modelled, which looks at raising Viet Nam's ambition beyond the SDG and the NDC targets:

(a) The BAU scenario. This scenario follows historical demand trends, based on growth projections, such as using GDP and population growth. It does not consider emission limits or renewable energy targets. For each sector, the final energy demand is met by a fuel mix reflecting the current shares in TFEC, with the trend extrapolated to 2030. Essentially, this scenario aims to indicate what will happen if no enabling policies are implemented or the existing policies fail to achieve their intended outcomes;

(b) Current policies scenario. Inherited and modified from the BAU scenario, this scenario considers all policies and plans currently in place. These are, for example, the emission reduction measures and power capacity expansion plan stipulated in the revised power development plan (PDP) 2011-2020 (ESCAP 2021c) and the proposed draft PDP 8 (Anh, Ngan and Huong 2020);

(c) SDG scenario. This scenario aims to achieve the SDG 7 targets, including universal access to electricity and clean cooking fuels, substantially increasing renewable energy share and doubling the rate of energy efficiency improvement. For clean cooking, different technologies (electric cooking stove, LPG cooking stove and improved cooking stove) have been assessed, subsequently recommending the uptake of the most appropriate technology. Energy saving opportunities have been analysed to identify options for achieving the SDG 7 energy intensity target;

(d) Coal phase-out scenario. Like the SDG scenario, this scenario aims to achieve the SDG 7 targets. In addition, this scenario also looks to phase out coal in line with the global call for eliminating it from the power sector, as well as realize the benefits of reduced cost of electricity generation from alternative energy technologies, and reduce the severe impacts on public health and local air environment from coal burning.

2.3. Economic analysis

The economic analysis considers the project's contribution to the economic performance of the energy sector. The purpose of a cost-benefit analysis (CBA) is to make better-informed policy decisions. It is a tool to weigh the benefits against costs and facilitate an efficient distribution of resources in public sector investment.

2.3.1. Basics of economic analysis

The economic analysis of public sector investment differs from a financial analysis. A financial analysis considers the profitability of an investment project from the investor's perspective. In an economic analysis the profitability of the investment considers the national welfare, including externalities. A project is financially viable only if all the monetary costs can be recovered in the project lifetime. Project financial viability is not enough in an economic analysis; contribution to societal welfare should also be identified and quantified. For example, in the case of a coal power plant, the emissions from the combustion process emits particulate matter that is inhaled by the local population, causing health damages and accelerating climate change. In an economic analysis a monetary value is assigned to the GHG emission to value its GHG emissions abatement.

2.3.2. Cost parameters

The project cost is the fundamental input in the economic analysis. The overall project cost is calculated using the following:

(a) Capital cost. Capital infrastructure costs for technologies are based on country-specific

data to improve the analysis. They include land, building, machinery, equipment and civil works;

(b) Operation and maintenance cost. This comprises fuel, labour and maintenance costs. Power generation facilities classify operation and maintenance costs as fixed ($/MW) and variable ($/MWh) costs;

(c) Decommissioning cost. Retirement of power plants costs related to environmental remediation, regulatory frameworks and demolition costs;

(d) Sunk cost. Existing infrastructure investments are not included in the economic analysis, since any additional investment is required by the project.

(e) External cost. This refers to any additional externalities that impose costs on society.

(f) GHG abatement. Avoided cost of CO_2 generation is calculated in monetary value based on the carbon price. The 2016 Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories is followed in the calculation of GHG emission for the economic analysis. The sectoral analysis is based on the Tier 1 approach, which uses fuel combustion from national statistics and default emission factors.

2.3.3. Scenario analysis

The scenario analysis evaluates and ranks scenarios, using the Multi-Criteria Decision Analysis (MCDA) tool, with a set of criteria and weights assigned to each criterion. The criteria considered in the MCDA tool can include the following; however, stakeholders may wish to add/remove criteria to suit the local context, including:

- Access to clean cooking fuel;
- Energy efficiency;
- Share of renewable energy;
- Emissions in 2030;
- Alignment with the Paris Agreement;
- Fossil fuel subsidy phased out;
- Price on carbon;
- Fossil fuel phase-out;
- Cost of access to electricity;
- Cost of access to clean cooking fuel;
- Investment cost of the power sector;
- Net benefit from the power sector;

This step is generally applied to all countries utilizing NEXSTEP in developing the national SDG 7 Roadmap, as a means to suggest the best way forward for the countries by prioritizing the several scenarios. Nevertheless, it has not been applied to Viet Nam, as only a limited number of scenarios have been developed.

3. Overview of Viet Nam's energy sector

3.1. Current situation

Geography and climate. Located in the South-East Asia subregion, Viet Nam occupies the eastern and southern parts of the Indochina peninsula in South-East Asia, with the South China Sea along its entire coast. The country occupies a land area of around 331,690 square kilometres, with an average extent of about 1,650 kilometres in a North-South direction and 600 kilometres in an East-West direction (Government of Viet Nam, 2021). Mountains and hills cover two-thirds of the mainland. Areas above 500 metres in altitude account for 70 per cent of the mainland. The highest mountain ranges lie in the west and north-west areas of the country (Government of Vietnam, 2021).

Population. The total population in Viet Nam was estimated to be 96.5 million in 2018. The population recorded in 2002 was 80 million (Government of Vietnam, 2021), which translates into an annual growth rate of 1.3 per cent between 2002 and 2018. The urban population percentage was estimated at 36 per cent in 2018, an annual increase of 2.8 per cent from 2000 (ESCAP, 2021).

Economy. Viet Nam's GDP is estimated to have been about US$262 billion in 2018 at current price. Correspondingly, GDP per capita stood at US$2,715. The growth in GDP per capita is remarkable, increasing at an average annual growth rate of 14.6 per cent since 2000, from just US$748 in 2000 (ESCAP, 2021a). According to the World Bank's country classification, Viet Nam is classified as a lower-middle income economy as of the 2021 fiscal year (World Bank, 2021). Nevertheless, with an average of about 7 per cent GDP growth during the past two decades, Viet Nam is one of the world's fastest-growing economies. This accelerated economic pace is due to the shifting of labour from agriculture to manufacturing and services, private investment, a strong tourist sector, higher wages and accelerating urbanization. Exports constitute an increasingly significant contribution to Viet

Nam's GDP, and certain sectors, such as industrial production, textile, electronics and seafood production, have been growing rapidly. While the COVID-19 pandemic has slowed growth slightly in recent years, the country has been able to remain in a positive position.

Climate change risks. Viet Nam has a high level of exposure to climate-related hazards, and extreme weather and climate events. Climate change is projected to increase temperatures, the severity and frequency of extreme weather events and sea level rise which, without additional interventions, will increase the number of people at risk of climate-sensitive diseases. The Global Climate Risk Index 2020 ranked Viet Nam as the sixth-most affected country in the world in terms of climate variability and extreme weather events during 1999-2018. Climate change is projected to increase the frequency of natural disasters and extreme heat events in most areas in Viet Nam. Inundation due to a sea level rise of 1 metre could affect about 16.8 per cent of the population of the Red River Delta, 1.5 per cent of the Central coastal provinces, 17.8 per cent of Ho Chi Minh City, and 38.9 per cent of the Mekong Delta (Tuyet Hanh and others, 2020).

3.2. National energy profile

Based on the data provided by the national consultant, the electrification rate in Viet Nam was 99.2 per cent in 2018. This leaves around 215,000 households yet to be connected to any form of electricity supply. Nevertheless, the progress in access to clean cooking fuel has not been as remarkable. In 2018, about 73 per cent of the population had access to clean cooking fuel and technologies. Liquefied petroleum gas (LPG) stoves are the dominant cooking technology used by urban households in Viet Nam, making up around 33 per cent share of total stove usage distribution. This is followed by the traditional biomass stove which has a share of 66 per cent, and includes the use of wood, agricultural residue and animal dung as fuel.

Modern renewable energy delivered approximately 16.7 per cent of TFEC in 2018. This excludes traditional biomass usage in residential cooking and heating, which corresponds to an estimated amount of 3,892 ktoe out of the total TFEC of 60.2 Mtoe. Viet Nam uses a wide range of fuel for power generation, predominantly fossil fuels. Coal, natural gas and diesel together constituted 64.8 per cent of the generation mix in 2018. Hydro supplied 34.9 per cent and the remaining small amount comes from solar PV, wind and biomass. While endowed with an abundance of hydropower, solar and wind potential, Viet Nam has not yet developed its renewable energy sector, but the proposed draft Eighth Power Development Plan (PDP 8) sets out plans for a stronger renewable energy share in the power sector. The energy intensity in 2018 was 4.8 MJ/US$$_{2011}$ (ESCAP, 2021c).

3.3. National energy policies and targets

Viet Nam's energy sector development is guided by several national policies and frameworks. These policies have been used as guiding references for the NEXSTEP modelling, to better understand the country context and to provide recommendations that adhere to the Government's overarching energy sector development. Where applicable, the currently implemented and adopted policies or regulations are considered in the current policy scenario, to identify gaps in achieving the SDG 7 targets. Major policies or strategic documents consulted include the following:

- Decision of the Prime Minister No. 428/QD-TTg of 2016 on the Approval of the Revised National Power Development Master Plan for 2011-2020 with the Vision to 2030 (ESCAP, 2021c):
  (a) The PDP, originally published in 2011 and updated in 2016, provides a detailed plan for the expansion of the power sector, including future capacity and generation mixes. It stipulates that in 2020, the total power generation capacity will be approximately 26,000 MW, generating about 131 billion kWh of electricity (i.e., about 49.3 per cent of electricity produced) and consuming approximately 63 million tons of coal. In 2025, the total capacity will be approximately 47,600 MW, generating about 220 billion kWh of electricity (i.e., about 55 per cent of electricity produced) and consuming approximately 95 million tons of coal. In 2030, the total capacity will be approximately 55,300 MW, generating about 304 billion kWh (about 55 per cent of electricity produced) and consuming approximately 129 million tons of coal. Electricity production from gas-fired thermal technologies, including liquified

natural gas (LNG), would be 19 per cent in 2030. Under the PDP, Viet Nam would also add nuclear to its power generation fleet, to reach approximately 3.6 per cent of total capacity by 2030.

(b) The PDP suggests steadily increasing the proportion of renewable electricity for the purpose of reduced dependence on imported coal-fired electricity, thus contributing to national energy security. The share of renewable electricity generation (excluding large- and medium-scale and pumped-storage hydropower) should increase to more than 10 per cent in 2030. The electricity produced from different renewable energy technologies in 2030 would be hydropower, 15.5 per cent, wind power, 2.1 per cent in 2030, biomass, 1 per cent in 2030, and solar, 3.3 per cent.

- The draft National Power Development Plan 8 is pending finalization. However, some details have been summarized by different sources (EIA, 2021; Lorimer and Doan, 2021; Yeap, 2021). Under PDP8, the total installed capacity in the country is expected to reach 138 GW by 2030, which includes 27 per cent from coal-fired thermal power, 19 per cent from gas thermal power, 18 per cent from hydroelectricity, 32 per cent from wind power, solar and biomass, and 4 per cent from imported sources.
- The Viet Nam National Energy Efficiency Program (VNEEP). The previous phase of VNEEP was a 10-year programme from 2006 to 2015. It was a targeted national programme, and the first-ever comprehensive plan to institute measures for improving energy efficiency and conservation across all sectors of the Vietnamese economy. The overall aim of the programme was to make initial savings of 3 to 5 per cent during 2006-2010 and a further 5 to 8 per cent during 2011-2015. In 2019, the Prime Minister issued Decision No. 280/QD-TTg approving the national program on economical and efficient use of energy for 2019-2030 (phase III of VNEEP), with a target of 10 per cent total energy savings – equivalent to 2,512 PJ – between 2019 and 2030 (Government of Viet Nam, 2020b; Teske and others, 2019). The specific objectives for VNEEP III are to:

  (a) Achieve energy savings of 8 to 10 per cent compared with the total national energy consumption for 2019-2030;

  (b) Reduce power losses in transmission to < 6 per cent;

  (c) Increase energy efficiency in various industrial sectors, with the following energy demand reduction targets:

    (i) Steel industry – 5-16.5 per cent (depending on the product type and production technology);

    (ii) Chemical industry – minimum 10 per cent;

    (iii) Plastics production industry – 21.6 to 24.8 per cent;

    (iv) Cement industry – minimum 10.9 per cent;

    (v) Textile industry – minimum 6.8 per cent;

    (vi) Beverage industry – 4.6 to 8.4 per cent (depending on the product type and production scale);

    (vii) Paper industry – 9.9 to 18.5 per cent (depending on the product type and production scale).

  (d) Reduce petroleum and oil consumption in transportation by 5 per cent compared with the sector's fuel consumption demand forecast until 2030; develop fuel standards for new and imported two-wheel motorbikes and minibuses;

  (e) Ensure that 90 per cent of industrial parks and 70 per cent of industrial clusters access and apply energy-efficiency measures;

  (f) Implement energy labelling for 50 per cent of all thermal insulation building material products;

  (g) Develop and approve local energy efficiency plans for all cities and provinces under the central Government.

- Viet Nam's updated NDC (Government of Viet Nam, 2020a), stipulates the following ambitions:

  (a) Viet Nam aims to reduce GHG emissions for the energy sector by 5.5 per cent by 2030 compared to the BAU scenario using domestic resources, which is equal to reducing 51.5 $MtCO_2$-e. This reduction will be achieved with domestic resources (unconditional target).

  (b) If international support is received, Viet Nam aims to increase its target to a 16.7 per cent reduction by the energy sector, compared to the BAU scenario. The share

of the energy sector in this target would be 16.7 per cent, or 155.8 $MtCO_2$-e.

3.4. National energy resource assessment

Viet Nam has a high potential for renewable energy, such as small-scale hydropower generation, biomass energy, wind energy and solar energy, which can be utilized to meet a large part of the national energy demand. The average annual solar radiation levels in Viet Nam are 4 to 5 kWh/m² per day. With this level of radiation, and discounting land areas that may have potential conflicts with national parks and other competing uses, Viet Nam has more than 1,900 km² of available land on which up to 48 GW of solar PV (ground mounted) can potentially be installed. Viet Nam's long coastal belt offers very high potential for developing wind power. The onshore potential for utility-scale wind farms, considering existing the land-use restrictions, is as high as 91 GW. Excluding mountain areas with slopes of less than 30 per cent, fractured spaces less than 1 km² and areas at a maximum distance of 10 km from a power line, this potential would be at least 40 GW. In addition, the offshore wind potential – taking into account coastal areas with a maximum water depth of 50 metres and a maximum distance to shore of 70 kilometres – Viet Nam has a technical potential of 609 GW, spread over a total 3,000 kilometres of coastline (Teske and others, 2019).

Viet Nam has a moderate level of fossil fuel energy resources including petroleum products, coal and biomass. While it has a significant amount of coal resources, given the plan for coal expansion in the power sector, the country will need to increase its coal import. Viet Nam produces less than half of its annual petroleum product needs, with the remainder being imported, which is expected to increase significantly to meet its growing transport sector. Its natural gas needs are largely met by domestic resources.

3.5. National energy balance 2018

The official national energy balance is not available for 2018. The estimated national energy consumption, built up using data collected from various sources, largely from the International Energy Agency (IEA 2021) and the Asia-Pacific Energy Portal (ESCAP, 2021a) is described below.

In 2018, TFEC was 60,274 ktoe. Most of the demand came from the industrial sector (54 per cent) (figure 2). This was followed by the transport sector (20 per cent) and the residential sector (16.7 per cent). Petroleum fuel was the dominant energy source in TFEC with a share of 33 per cent, followed by electricity (27 per cent) and coal (23.5 per cent). The transport sector, which operates predominantly with internal combustion engine vehicles, is the main consuming sector for oil products (60.5 per cent). Oil products are also used in all other sectors including industrial, residential, commercial and agriculture sectors, and about 7 per cent is used as non-energy for industrial processes. Figures 2 and 3 illustrate the total final energy consumption (TFEC) by consuming sector and fuel type.

Figure 2. Total final energy consumption by sector, 2018

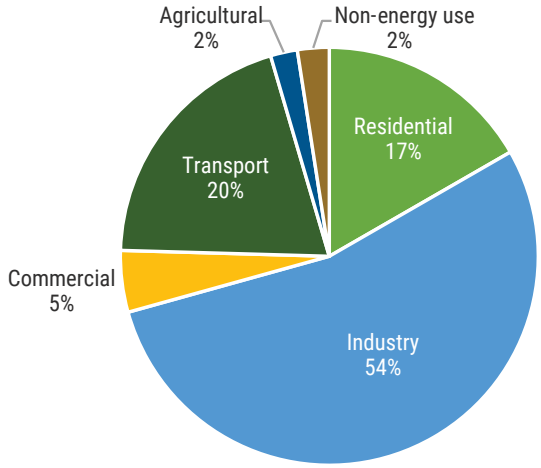


Figure 3. Total final energy consumption by fuel type, 2018

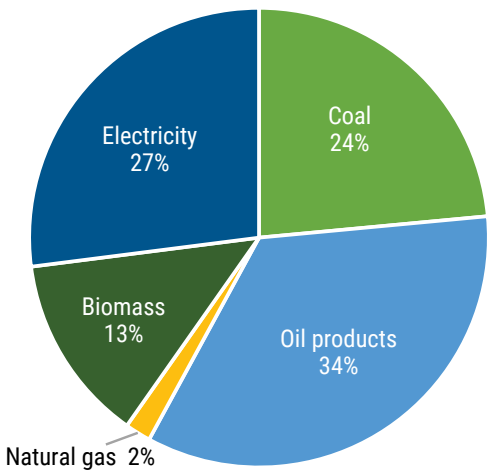
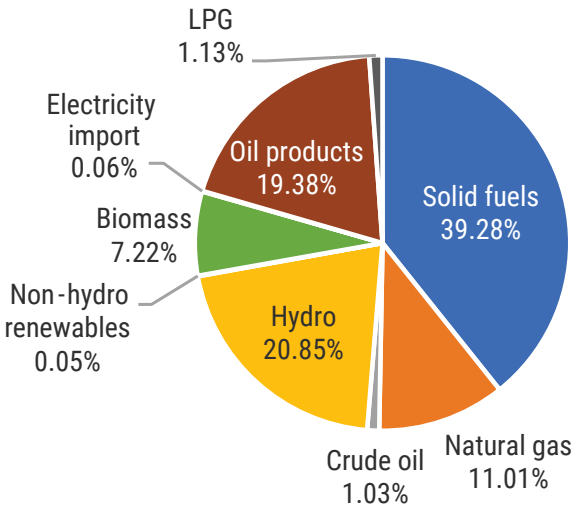


Figure 4. Total primary energy supply by fuel type, 2018



The total primary energy supply (TPES) in 2018 was 98,710 ktoe. Coal contributed the highest amount (39 per cent), followed by hydropower (21 per cent) and oil products (20 per cent) (figure 4).

3.6. Energy modelling projections

The energy demand is estimated using the activity level and energy intensity in the LEAP model. The demand outlook throughout the NEXSTEP analysis period is influenced by factors such as annual population growth and annual GDP growth. The assumptions used in the NEXSTEP modelling are summarized in table 1 for the three main scenarios (i.e., BAU, CPS and SDG scenarios).

Table 1. Important factors, targets and assumptions used in NEXSTEP modelling

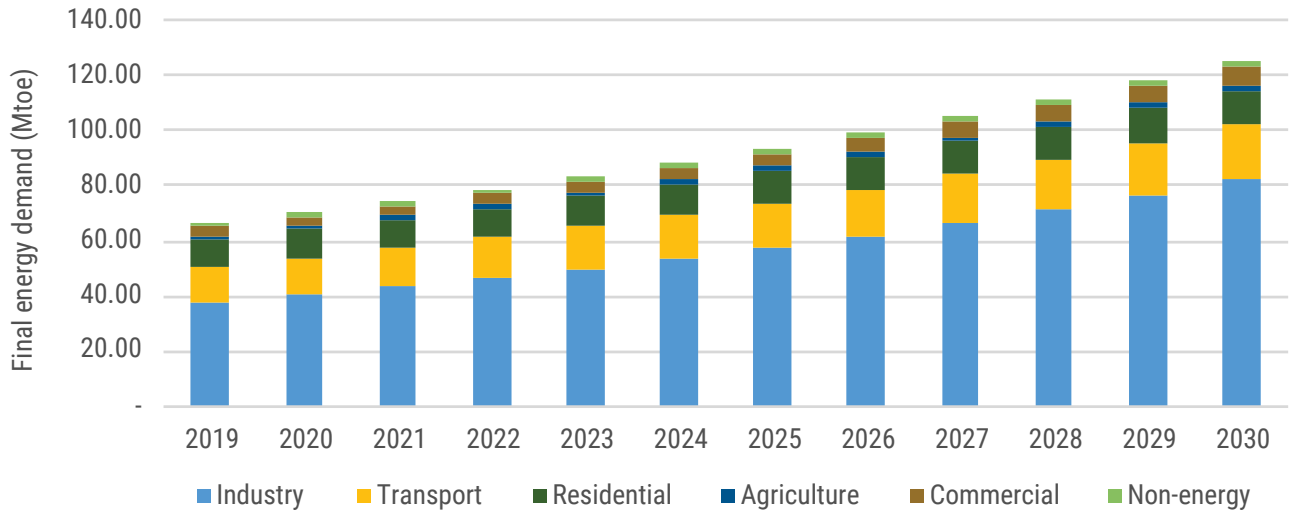
Parameters	Business as Usual (BAU) scenario	Current Policy (CP) Scenario	Sustainable Development Goal (SDG) scenario
Economic growth	7.0 % per annum		
Population growth	0.7 % per annum		
Urbanisation rate	36 per cent in 2018, gradually increasing to 50 per cent in 2030		
Commercial floor space	28.3 million m^2 in 2018, increasing at the same growth as GDP		
Transport activity	Transport activities in 2018 were 185.3 billion passenger-kilometres and 154.1 billion tonne-kilometres, with assumed growth of 5.1 per cent annually		
Access to electricity	2018: 99.2 per cent. 2021 would be: 100%	2021: 100%	2021: 100%
Access to clean cooking fuels	Access rate was 73.1 per cent in 2018, based on historical trend and using linear forecasting method, the rate would be 93.1 per cent.	In the absence of any specific policy measures, the access to clean cooking is expected to be the same as in BAU.	Building on the Current Policy Scenario, NEXSTEP further recommends the use of a combination of LPG and electric stove in reaching a 100% access rate.
Energy efficiency	In 2018, the energy intensity was 4.8 MJ/US$. Additional energy efficiency measures not applied	Improvement based on current policies (further explained in section 3.7)	1.8 per cent annual improvement in TPES target achieved
Power plant	Based on 2018 capacity share	Power generation capacities has been modelled as suggested in the revised PDP 7 and proposed PDP 8, as discussed in section 3.3.	RE capacity increased from 17.6 GW in 2018 to 83 GW in 2030 (including large hydro) to achieve the NDC target.

3.7. Energy demand outlook

In the current policy settings, TFEC is projected to increase from 66.5 Mtoe in 2019 to 125 Mtoe in 2030. This corresponds to an average annual growth rate of about 8 per cent, a number higher than the projected growth in GDP (7 per cent) and population (0.7 per cent). This increased growth is predominantly due to the increase in industrial activities which will see a growth of more than 10 per cent leading to 2030.

In 2030, the industrial sector will remain the main consuming sector, with an estimated TFEC at 82 Mtoe (65.9 per cent), followed by the transport sector at 19.9 Mtoe (15.9 per cent), residential sector at 12.8 Mtoe (10 per cent), commercial sector at 6.5 Mtoe (5.1 per cent) and others 3.9 Mtoe (3.1 per cent). The sectoral overview of energy demand in the current policy scenario is discussed below and shown in figure 5.

Figure 5. Energy demand outlook, 2019 - 2030



(a) Industry

As mentioned above, the industry sector will continue to dominate Viet Nam's TFEC, with a 66 per cent share in 2030. The subsectoral demand will be dominated by food processing (16 per cent), electronic and electrical (16 per cent), automotive and machinery (14.6 per cent) and textile apparel and leather (11.6 per cent) industries.

(b) Transport

Viet Nam's transport sector consists of passenger road transport and freight road transport. The total energy demand is projected to be 19.87 Mtoe in 2030, an increase from 13.12 Mtoe in 2019. While its growth is much slower than that of the industrial sector, it will continue to be the second-largest energy consuming sector to 2030. Among the passenger vehicle categories in 2030, motorcycles will consume the most at 10.25 Mtoe (88.4 per cent), followed by private cars at 1.13 Mtoe (9.8 per cent) and buses at 0.21 Mtoe (1.8 per cent).

(c) Residential

In 2030, the residential sector will consume 12.7 Mtoe, which is an annual growth of 2.3 per cent, up from 10.14 Mtoe in 2019. The urban and rural split of energy consumption would be 55.9 per cent and 44.1 per cent, respectively. In terms of fuel, electricity will be the main energy source with just over 60 per cent, followed by 28.4 per cent biomass with the remainder being LPG. As mentioned above, in the absence of any specific policy on improving access to clean cooking fuel and

technologies, it is assumed that households will continue to use biomass for their cooking needs at the same rate as in the base year.

(d) Commercial

Total energy consumption in the commercial sector will increase at an average annual growth of 10 per cent from about 3 Mtoe in 2019 to 6.5 Mtoe in 2030. In this sector, oil will be the key energy supply at 46.7 per cent, followed by electricity at 29.5 per cent and coal at 23.8 per cent.

3.8. Electricity generation outlook

The 2030 demand for electricity in the current policy scenario will be 446 Terawatt-Hours (TWh), an increase from 229 TWh in 2019. The demand will be the highest in the industrial sector at 326 TWh (73 per cent), followed by the residential sector (89 TWh, 20 per cent), the commercial sector (22 TWh, 5 per cent) and the agriculture sector (8.4 TWh, 2 per cent).

Viet Nam's installed electric power generation capacity in 2018 was 42.82 GW, of which 43.3 per cent was provided by coal, followed by hydro, 39.8 per cent, gas, 13.4 per cent, diesel at 2.2 per cent diesel and renewables (including solar, wind and biomass) at the remaining 1.3 per cent. To meet the increasing power demand in the country, Viet Nam has an ambitious plan to expand its power sector as discussed in section 3.3. Under this plan, coal generation capacity will increase to 138 GW in 2030. The shares of this expansion are shown in table 2 and figures 6 and 7.

The projected generation by technology type is as illustrated in figure 6. Coal-based power supply will continue to dominate the electricity system as per the Government's plan to further expand its coal fleet. Hydropower generation will increase by a relatively smaller amount. Remarkable additions will be solar PV, onshore wind and offshore wind. As per the plan, nuclear is expected to be added to the fleet to constitute 3.6 per cent of the total capacity.

Table 2. Power generation capacities in 2018 and 2030, and share of generation in 2030

Power generation technologies by fuel	Capacity in 2018 (GW)	Capacity in 2030 (GW)	Share of generation in 2030 (%)
Coal	18.52	37.40	37.43
Hydro	17.03	20.98	14.53
Natural gas	5.71	27.46	21.14
Solar PV	0.14	15.88	5.16
Onshore wind	0.19	20.21	9.65
Offshore wind	0.00	4.38	2.29
Biomass	0.27	2.35	2.17
Nuclear	0.00	4.97	4.59
TOTAL	**42.82**	**138.00**	**100.00**

Figure 6. Power capacity installed, CPS scenario

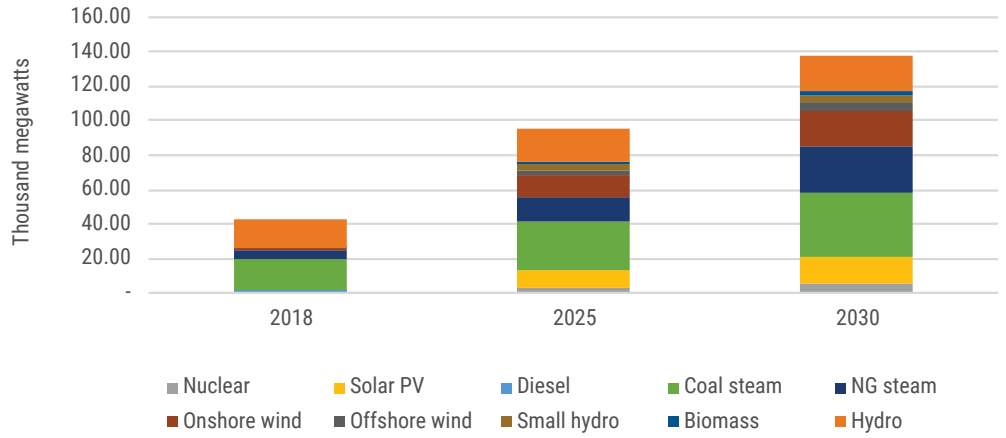
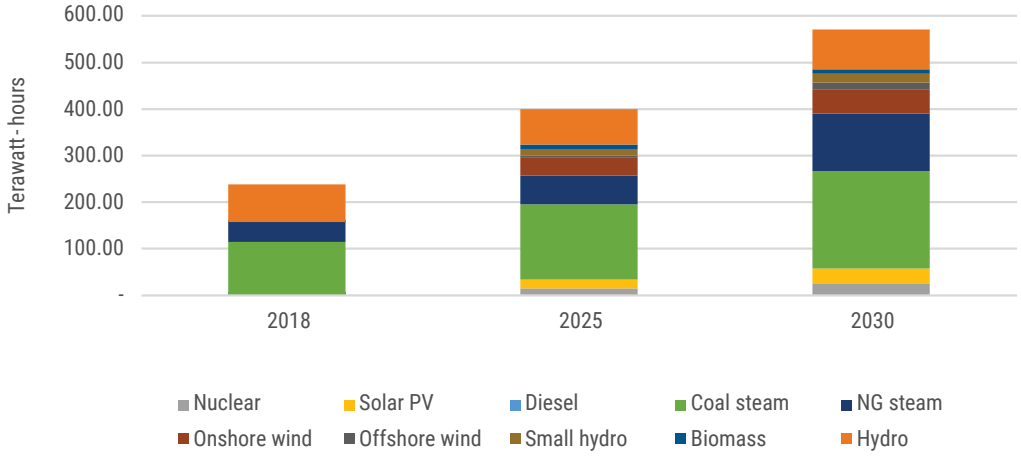


Figure 7. Electricity output by technology type, CPS scenario



3.9. Energy supply outlook

As mentioned briefly in section 3.5, in the current policy scenario TPES is forecast to increase from 43.9 Mtoe in 2018 to 99 Mtoe in 2030.

The fuel shares in 2030 are projected to be: oil products, 37.7 Mtoe; biomass, 16.1 Mtoe; hydro, 23 Mtoe; coal, 88.8 Mtoe; natural gas, 32.9 Mtoe; nuclear, 6.8 Mtoe; and renewables, 8.4 Mtoe. The substantial increase of coal and natural gas in energy supply is due to the need to meet the rising power demand in the industrial sector. In addition, a substantial renewable energy capacity has been added to complement fossil fuel generation. However, the increased use of coal will eventually increase the country's reliance on imported fuel, as in the case of oil products to meet the rising demand in the transport sector. Although the share of biomass in the total primary energy supply is likely to be reduced due to the increase in urbanization (half of the population is expected to live in urban areas by 2030), its supply will still remain significant.

3.10. Energy sector emissions outlook

The energy sector emissions from the combustion of fossil fuel are calculated based on IPCC Tier 1 emission factors assigned in the LEAP model, and expressed in terms of 100-year global warming potential (GWP) values. For the combustion of biomass and biomass products, the carbon emissions are not attributed to the energy sector but are accounted for in the Agriculture, Forest and Land Use Change (AFOLU)[6] as per the accounting

6 AFOLU is not within the scope of NEXSTEP.

system suggested by IPCC. Nevertheless, the emissions of other GHGs, such as methane and nitrous oxide, are included in the total emissions in the energy sector.

In the revised NDC document submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2020, Viet Nam committed to reducing its emissions by 5.5 per cent, equal to 51.5 $MtCO_2$-e, from the energy sector, compared to the BAU scenario by 2030 with domestic resources. In the conditional target, this would be increased to a reduction of 155.8 $MtCO_2$-e (16.7 per cent). However, this BAU emission scenario assumed that the energy sector's emissions would rise to about 930 $MtCO_2$-e by 2030. The NEXSTEP analysis has identified the fact that emissions in the current policy scenario will increase to a much lower level of 564 $MtCO_2$-e by the same year. This difference is possibly due to different sets of assumptions used in those two analyses. Therefore, in setting the target, this analysis has used the absolute quantities instead of the percentages. As such, the emission levels have been estimated at 512 $MtCO_2$-e for the unconditional target and 408 $MtCO_2$-e for the conditional target.

In the current policy scenario, total GHG emissions from the energy sector increase from 259 $MtCO_2$-e to 534 $MtCO_2$-e. The substantial increase is again due to the increased amount of coal and gas usage in the power sector as well as increased petroleum fuel in the transport sector. The transformation sector is emission-free as all electricity is generated from hydro and solar only. Figure 8 shows emissions from the demand side, whereas figure 9 shows supply side emissions from the power sector.

Figure 8. Emissions of the demand side under the current policy scenario

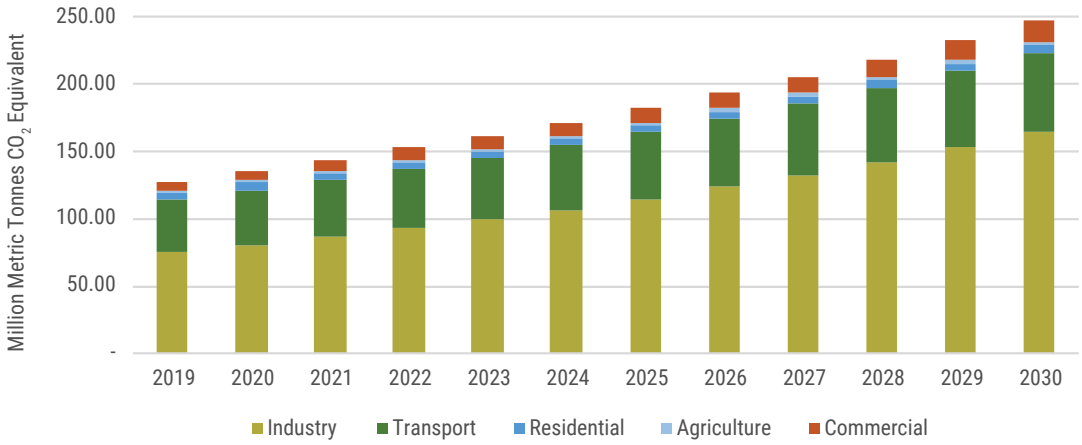
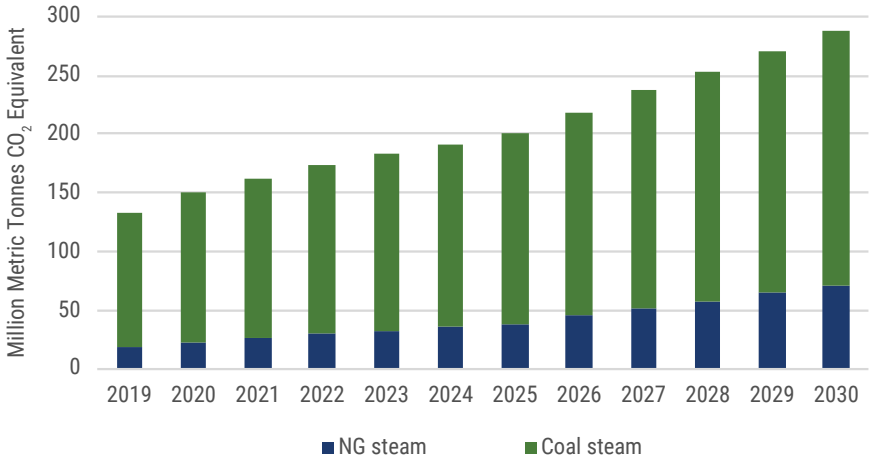
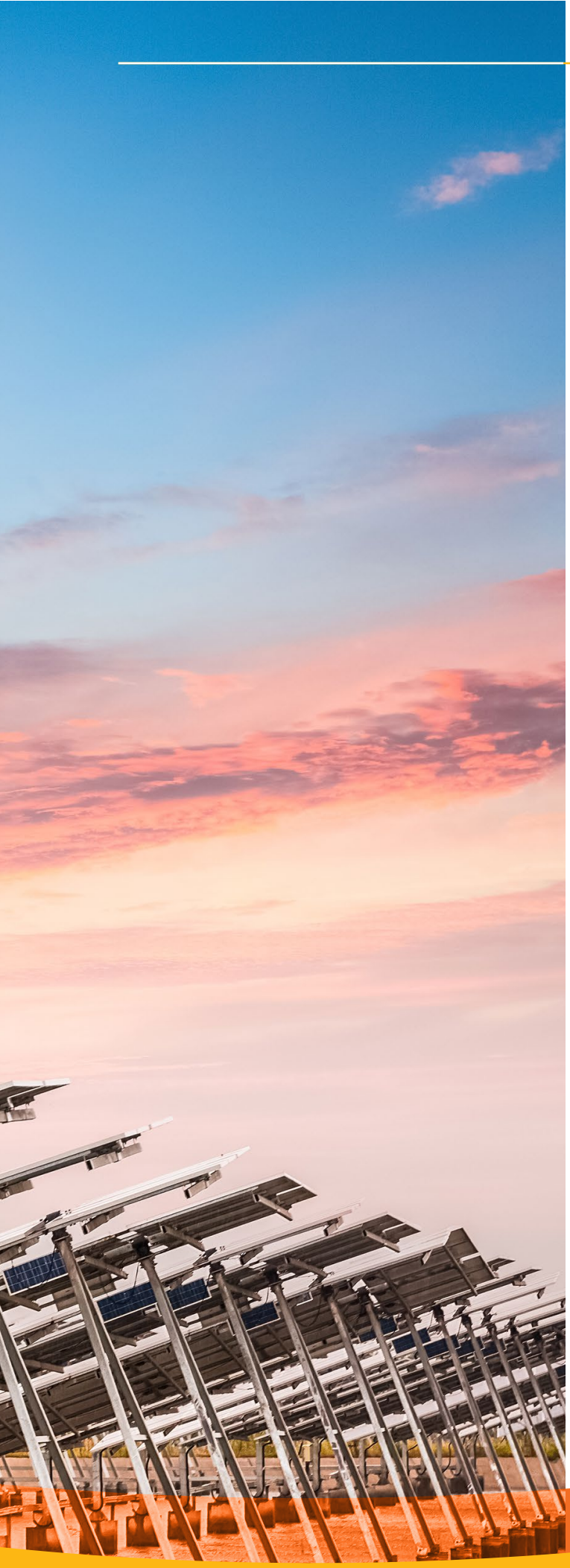


Figure 9. Emissions from the power sector under the current policy scenario



4. SDG scenario – achieving SDG7 by 2030



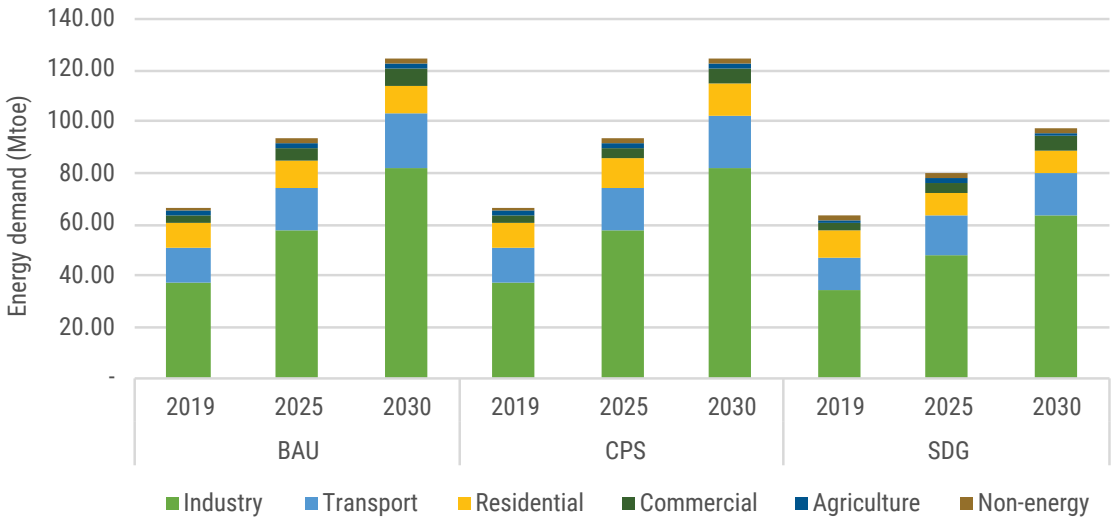
Access to affordable, reliable, sustainable and modern energy is essential in achieving the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change. Viet Nam has made remarkable progress in providing universal access to electricity, increasing access to 99 per cent in 2019. It is assumed that the country has already achieved the universal access by 2021. Nonetheless, the access to clean cooking fuel, which is still far from universal, was recorded as 73.1 per cent in 2018, leaving about 2 million households still relying on cooking with biomass. The renewable energy share in TFEC in 2018, excluding biomass, was 16.7 per cent, and 21.9 per cent when biomass is included. The share of renewable energy in TFEC will need to increase further to achieve the SDG 7 target. Energy intensity in 2018 was 4.8 MJ/US$, which will need to be reduced to 3.7 MJ/US$, at an annual rate of 1.8 per cent, to be able to achieve the SDG 7 target for energy efficiency improvement. All these targets have been modelled and analysed in the SDG scenario to ensure Viet Nam achieves the SDG 7 targets, together with the unconditional NDC target for the energy sector. This is discussed further in this chapter.

4.1. SDG Energy demand outlook

In the SDG scenario, TFEC increases to 97.6 Mtoe in 2030, a decline of about 27.4 Mtoe compared to the current policy scenario (about 22 per cent reduction). This decrease has been due to the switch from inefficient biomass cooking stoves to more efficient LPG and electric cooking stoves as well as improved energy efficiency across different sectors, e.g., through Minimum Energy Performance Standards (MEPS) in the residential sector (further discussed later in this report), energy efficiency in the industry sector through the VNEEP and a partial switch from internal combustion engine vehicles to electric vehicles in the transport sector.

In 2030, the industry sector will continue to have the largest share of TFEC at 63 Mtoe (64.6 per cent), followed by the transport sector (17.3 Mtoe, 17.7 per cent), the residential sector (8.7 Mtoe, 8.9 per cent), the commercial sector (5.2 Mtoe, 5.3 per cent) and others (3.5 Mtoe, 3.6 per cent). Figure 10 shows the projected TFEC by sector under the SDG scenario.

Figure 10. Projection of TFEC by sector in different scenarios



4.2. SDG 7 targets

4.2.1. SDG 7.1.1 Access to electricity

Viet Nam is assumed to already have achieved universal access to electricity by 2021, which needed a 0.8 percentage point increase from the 2019 rate of 99.0 per cent. Therefore, this roadmap does not discuss this indicator further. However, a deeper study of the level and quality of access would be appropriate in order to ensure that households continue to enjoy reliable access, and not just connection, as stipulated in Tier 3 of the World Bank's Multi-Tier Framework for access to electricity (ESMAP 2015).

4.2.2. SDG 7.1.2 Access to clean fuels and technologies for cooking

Under the current policy settings, using the historical trend and linear forecasting method, it is estimated that the clean cooking access rate will increase presents a risk to the country due to potential price and supply shocks, as LPG is largely imported. Henceforth, it will be important for Viet Nam to reduce the use of LPG cooking stoves. This becomes a challenging task as, in addition, traditional biomass cooking stoves will need to be completely eliminated by 2030, as per the SDG 7 target. Also, it is assumed that there is a large share of households that will not be able to afford the higher purchase cost of electric cooking stoves. Based on these assumptions, this analysis recommends a combination of LPG and highly-efficient induction type electric cooking stoves to achieve universal access by 2030. These technologies are also more cost-effective than biogas digesters. Subsection 4.4.2 details the evaluation of the various clean cooking technologies considered in the analysis. Due to the limited availability of data, an equal split of 50:50 share of these two technologies has been assumed. A summary of quantitative and qualitative analyses of different cooking stove technologies is given below.

(a) Electric cooking stoves

Electric cooking technology is classed as Level 5 in the World Bank MTF for Indoor Air Quality Measurement. Electric cooking stoves are more efficient than other types of cooking stoves, including gas stoves. Electric cooking stoves can generally be divided into two types – solid plate and induction plate. While solid plate cooking stoves use a heating element to transmit radiant energy to the food and reach about 70 per cent efficiency, induction plate cooking stoves use electromagnetic energy to directly heat pots and pans, and can be up to 90 per cent efficient.

(b) Improved cooking stoves

Studies suggest that ICS programmes often have low adoption rates due to the inconvenience of use, preference for traditional

cooking stoves, and the need for frequent maintenance and repairs. ICS programmes initially require strong advocacy to promote adoption, after which they require ongoing follow-up, monitoring, training, maintenance and repairs in order to facilitate continuing usage. In addition, based on the World Health Organization (WHO) guidelines for emission rates for clean cooking, only certain types of ICS technology comply, particularly when considering that cooking stove emissions in the field are often higher than they are in the laboratory setting used for testing.

(c) Biogas digester

Biogas digesters have high upfront capital costs (about US$1,000 for a standard size that is suitable for a four-member family) and require substantial subsidy due to their longer payback period. The technology is not favoured in rural areas due to the cultural reluctance to using animal or human waste for cooking. In addition, a standard size biogas digester requires two to four cows, depending on the size of the cow, to produce enough feedstock for daily gas demand for a household.

(d) LPG cooking stove

LPG supply in Viet Nam is constrained due to fuel import dependency and supply chain challenges. LPG cooking stoves generate lower indoor air pollution compared to ICS; they are classified as Level 4 in World Bank Multi-Tier Framework (MTF)[7] for cooking exposure, and reduce indoor air pollution by 90 per cent compared to traditional cooking stoves.

Table 3 summarizes the estimated annualized cost of different cooking technologies in the context of Viet Nam.

Table 3. Annualized cost of cooking technologies

Technology	Annualized cost
ICS	US$41
Electric stove	US$108
Biogas digester	US$131
LPG stove	US$154

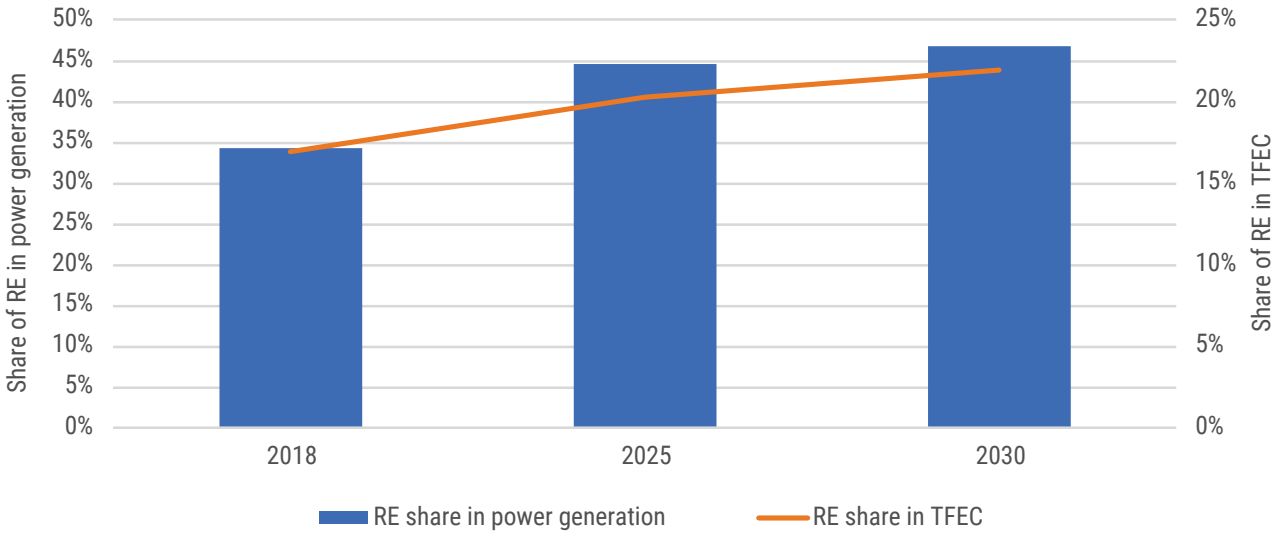
4.2.3. SDG 7.2 Renewable energy

SDG 7.2 does not have a quantitative target, but it encourages a "substantial" increase of renewable energy share in the TFEC. In normal circumstances, the NEXSTEP methodology first estimates the net increase in energy demand in response to universal energy access (both electricity and clean cooking) and energy efficiency improvement. It then uses the unconditional NDC target for the energy sector to estimate the optimum renewable energy share in the TFEC.

As per the revised NDC of Viet Nam, the energy sector would need to reduce 51.5 MtCO2-e of emissions unconditionally compared to the BAU scenario by 2030. The SDG scenario uses this emission reduction target as the guiding mechanism for increasing the share of renewable energy in the power sector. In addition, several energy efficiency measures have been applied across different sectors to leverage the opportunity of lower energy demand. Collectively, these measures will lead to increasing the share of renewable energy in the TFEC to 22 per cent in 2030, whereas the share of renewables in the power generation mix will increase from 0.3 per cent in 2018 to 31.5 per cent in 2030 (figure 11).

7 See http://documents.worldbank.org/curated/en/937711468320944879/pdf/88699-REVISED-LW16-Fin-Logo-OKR.pdf

Figure 11. Renewable energy shares in TFEC and power generation, 2030



This share of renewable energy has helped Viet Nam to achieve the NDC unconditional target (discussed in the emissions section).

4.2.4. SDG 7.3 Energy efficiency

The primary energy intensity, a proxy for the measurement of energy efficiency improvement, is calculated as 4.8 MJ/US$$_{2011}$$ in the CP scenario, which corresponds to an annual rate of improvement of 0.73 per cent, much less than what is required under the SDG scenario (1.8 per cent). In the SDG scenario, increased energy efficiency across different sectors will help to exceed the SDG target of 3.73 MJ/US$.

As discussed in section 3.3, the Viet Nam National Energy Efficiency Program (VNEEP) III aims to reduce energy consumption across the entire economy; however, specific numbers have been mentioned in the industrial sector. These numbers are to increase energy efficiency in various industrial sectors, with the following energy demand reduction targets:

- Steel industry – 5 to 16.5 per cent (depending on the product type and production technology);
- Chemical industry – a minimum 10 per cent;
- Plastics production industry – 21.6 to 24.8 per cent;
- Cement industry – a minimum 10.9 per cent;
- Textile industry – a minimum 6.8 per cent;
- Beverage industry – 4.6 to 8.4 per cent (depending on the product type and production scale);
- Paper industry – 9.9 to 18.5 per cent (depending on the product type and production scale).

This scenario suggests that a 20 per cent energy improvement is mandated across the entire industrial sector in order to limit the high energy consumption growth in this sector. However, this should be done without creating an adverse impact on productivity. The return on investment for any energy efficiency project will vary, depending on the company policy and the area of investment. However, in general, a payback period of up to three years has been found to be suitable (Alcorta and others, 2014).

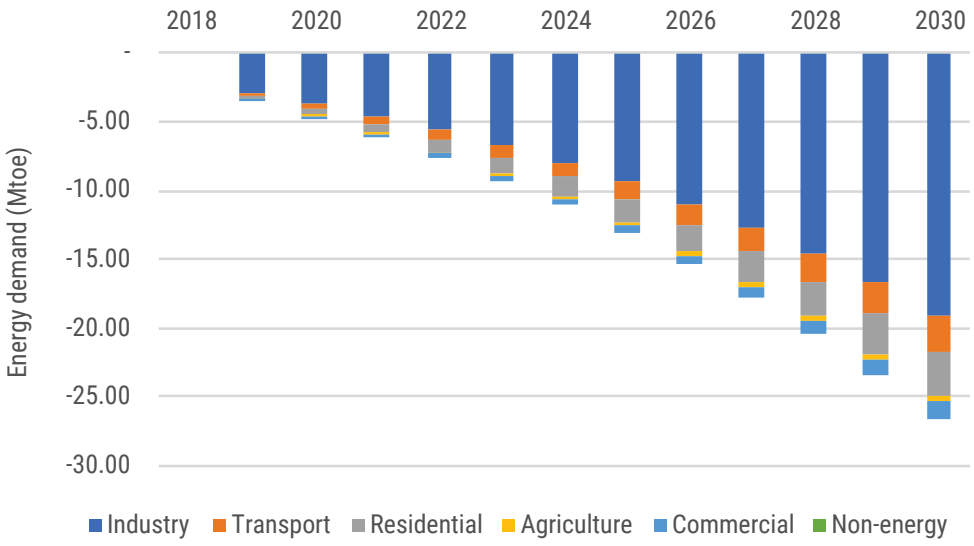
For the residential and commercial sectors, MEPS is already in place in Viet Nam. NEXSTEP analysis suggests that the MEPS target is further increased to enable a 50 per cent uptake of efficient appliances for all appliances by 2030. For the transport sector, NEXSTEP analysis suggests that by 2030, 30 per cent of motorcycles and passenger cars, and 50 per cent of buses should be electric.

It is estimated in this scenario that the energy intensity would be reduced to 3.52 MJ/US$ by 2030. Energy saving in the SDG scenario compared to the current policy scenario across different sectors is shown in figure 12.

Box 1. Viet Nam's energy efficiency target explained

For the calculation of the energy efficiency target for Viet Nam the base period rate for calculating energy efficiency improvements is 1990-2010. ESCAP Asia- Pacific Energy Portal data for primary energy intensity are used to analyse improvements in the base period. In 1990, the primary energy intensity for Viet Nam was 6.6 MJ/ US$$_{2011}$, which improved to 5.5 MJ/ US$$_{2011}$ by 2010. The compounded annual growth rate (CAGR) for primary energy intensity improvements in the base period is 0.9 per cent. The SDG target for energy efficiency requires doubling of improvement in primary energy intensity, which is 1.8 per cent per year. As the energy intensity in 2018 was 4.8 MJ/ USD$_{2011}$, this corresponds to an energy intensity target of 3.73 MJ/USD$_{2011}$ in 2030. This also takes into account the adjustment factor, as per the SDG 7 methodology, to adjust for the average changes between 2011 and 2017.

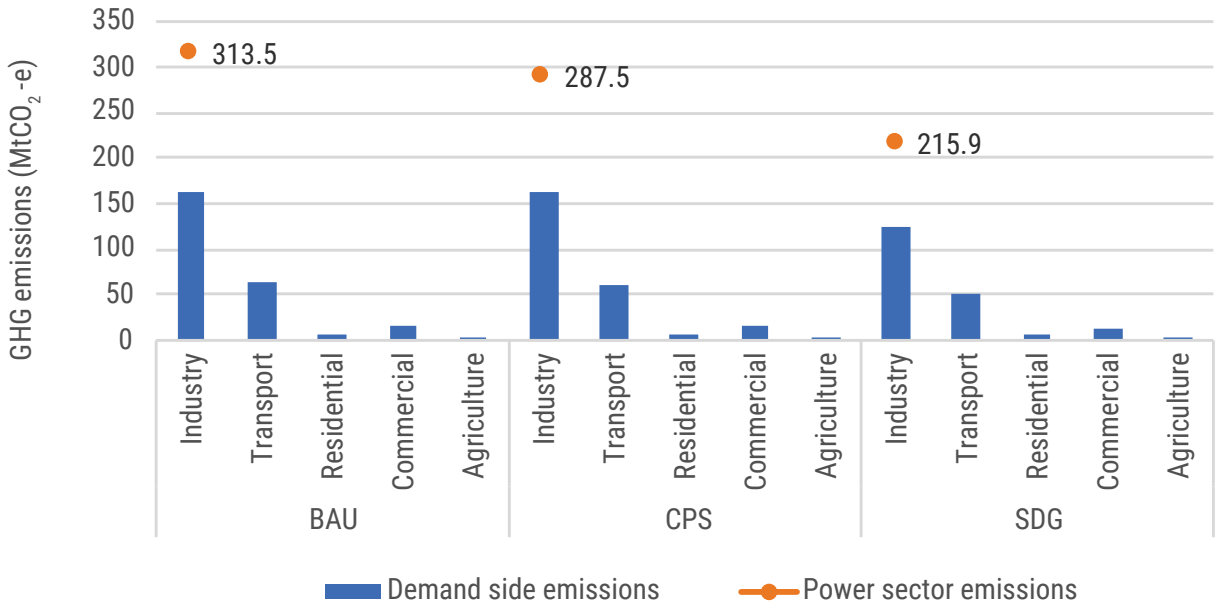
Figure 12. Energy savings by sector in the SDG scenario, compared to CPS



4.2.5. GHG emissions

The emissions from the BAU and CP scenarios are projected to reach 564 $MtCO_2$-e and 534 $MtCO_2$-e, respectively, in 2030. The emissions in the SDG scenario are projected to be 413 $MtCO_2$-e in 2030, much lower than the unconditional NDC target of 512 $MtCO_2$-e. In fact, this amount is slightly less than the conditional target of 408 $MtCO_2$-e. Figure 13 shows sectoral emissions (demand side) and total emission in the power sector by scenario.

Figure 13. Sectoral emissions and power sector emissions by scenario, 2030



4.3. Power generation in the context of SDG 7

The electricity demand in the SDG scenario is projected to increase from 249 TWh in 2019 to 591 TWh in 2030. This projection has considered the assumed growth in different economic sectors, with the increased power export capacity of Viet Nam reaching 198.4 TWh in 2030. This is compared with the 2018 export amount of 71.7 TWh in 2018. In this scenario, coal-fired power generation capacity slightly increases with the addition of another 7 GW (assuming the completion of the projects that are already in pipeline) and it then models the system with no new coal-fired power plants after 2022. The coal capacity then continues at the same level, but more capacity for wind is added in this scenario. Onshore and offshore wind will reach capacities of 25 GW and 15 GW, respectively, in 2030. The projected capacity mix is shown in figure 14 and the share of electricity by technologies is shown in figure 15.

The projected total investment for the planned power capacities is US$145.4 billion (capital cost for power plants only). The total net benefit (or "total net cost" as it returns a negative value) during the 12-year analysis period is expected be US$133 billion. This is about US$9 billion less than the net benefits in the CPS. However, it reduces the hazardous health impacts arising from coal burning.

Figure 14. Capacity mix in power generation in the SDG scenario

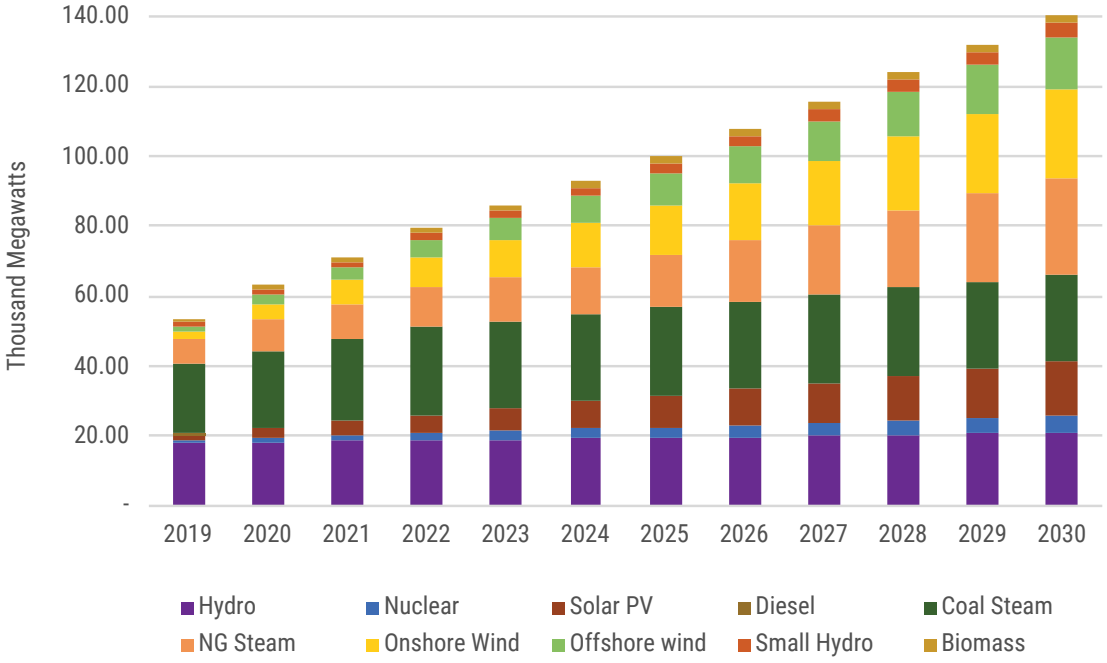
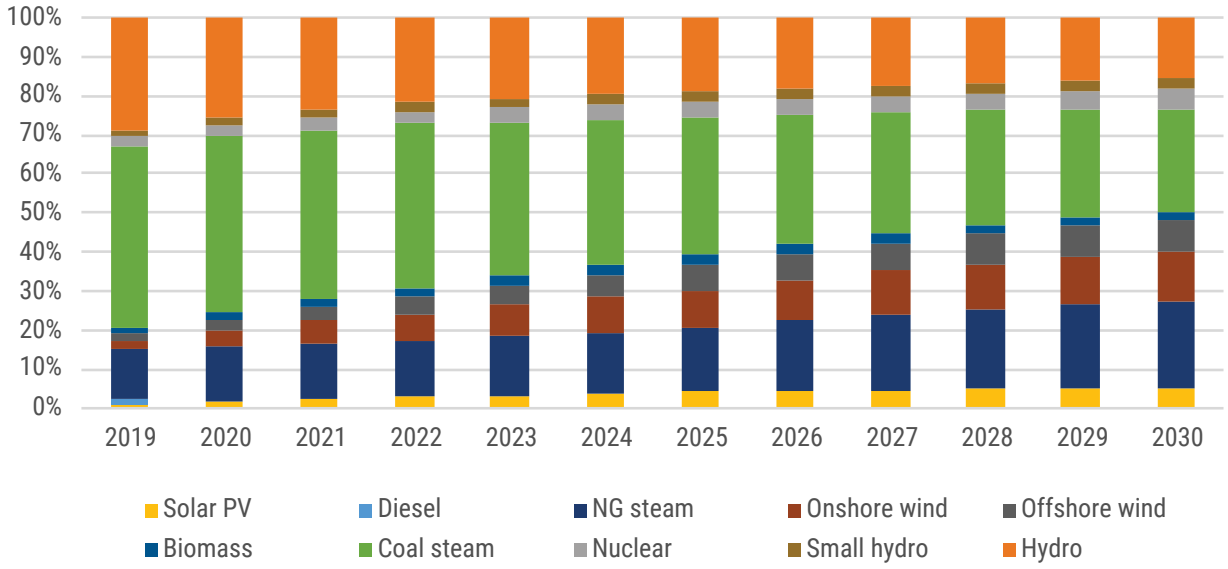
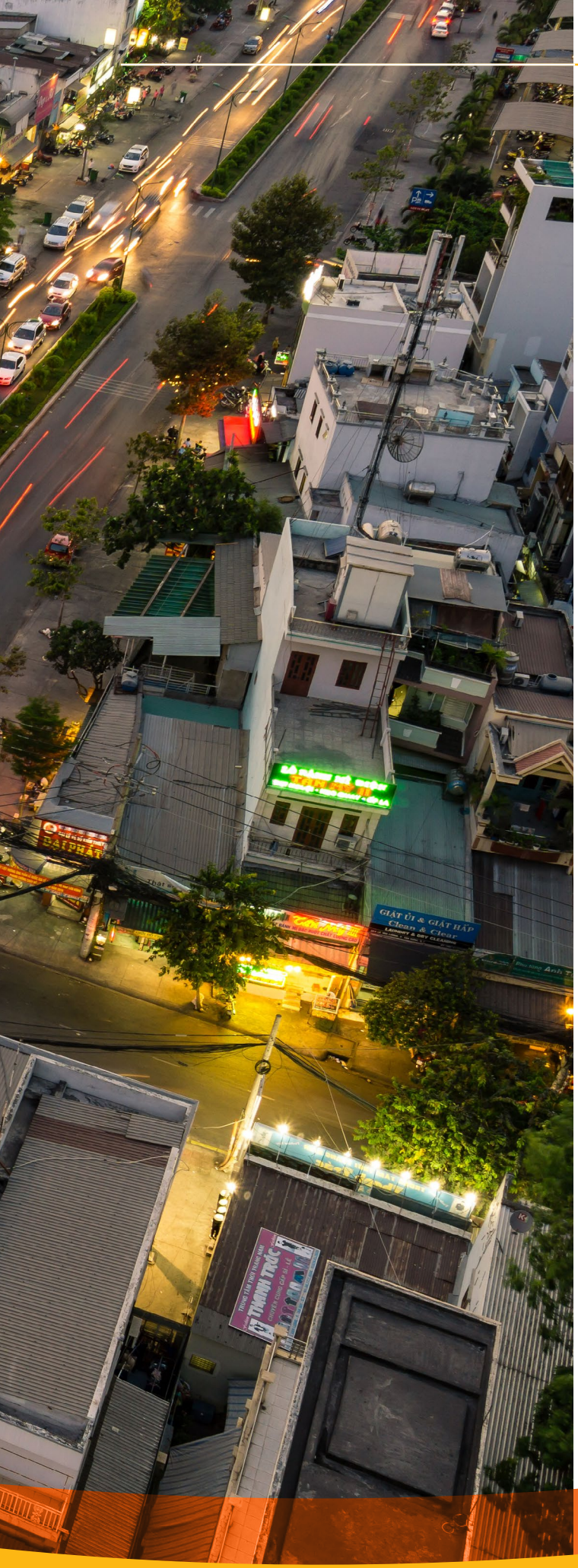


Figure 15. Share of electricity output by technology type, SDG scenario



5. Energy transition pathway with increased ambitions



The SDG scenario builds on the current policy settings to provide recommendations in achieving the SDG 7 targets. Further analysis shows that there are ample opportunities for Viet Nam to raise its ambition beyond just achieving the SDG 7 targets. In this scenario, the potential and opportunities for coal phase-out has been explored in parallel with taking advantage of the vast potential of renewable energy resources in the country.

Viet Nam has the resources and opportunity to become the renewable energy powerhouse of South-East Asia as the world undergoes a climate change and technology-driven energy transformation. The power sector expansion strategy can be altered to limit new coal power plants as discussed in the SDG scenario. In addition, Viet Nam may consider gradually shutting down existing capacities to meet the global benchmark for coal phase-out in line with the Paris Agreement goals. Such a move will significantly reduce chronic air pollution, deaths, and other environmental and social issues caused by the mining and burning of coal for power generation.

5.1. Global drivers for moving away from coal

Studies suggest that a pathway that is energy-efficient and renewables-led, backed by hydropower and natural gas, is Viet Nam's lowest cost option to rapidly meet energy demand through to 2030 (Mckinsey 2019; Khanh, 2018). Such a transition would: (a) reduce the reliance on imported fuel; (b) reduce financial pressure from mobilizing US$60 billion investment for the construction of coal thermal power plants; (c) avoid the risk of stranded assets of these coal power plants well before their financial lifetime; (d) and result in foreign reserve savings of US$7 billion/year. Such a pathway would also mean avoiding approximately 7,600 premature deaths annually by 2030, compared to the current policy scenario, and would create an additional 465,000 jobs in Viet Nam between 2017 and 2030.

Globally, coal power use needs to fall by 80 per cent by 2030 to keep global warming below 1.5°C, according to the Intergovernmental Panel on Climate Change, and the United Nations called for 2020 to be the global end date for new coal plant proposals (Shearer and others, 2020). To be consistent with the Paris Agreement, a large part of the current coal capacity in the Asian region, including Viet Nam, would need to be retired early, well before the assumed lifetime of 40 years, and/or utilized with a capacity factor less than 50 per cent. In order to be in line with GHG emissions reductions that would meet the Paris Agreement's temperature goals, the following key benchmarks have been identified for coal use in power generation in Asia: (a) no new coal generation after 2020; (b) a reduction in coal for power generation by 63 per cent below 2010 levels in non-OECD countries by 2030; and (c) full phase-out across Asia-Pacific by 2040 (ESCAP, 2021a).

5.2. Increasing the number of coal-fired power plants poses an economic risk

UNESCAP estimates across different countries for the Levelised Cost of Electricity (LCOE) finds that the costs of generation from solar PV and wind are already cheaper than coal-fired power (ESCAP, 2020), which is also confirmed by the International Energy Agency (IEA) in its latest report on LCOE (IEA, 2021). Further, recent auctions and power purchase agreements (PPAs) indicate that the LCOE of renewable-based electricity will be more than one-fifth less than coal-fired power plants (IRENA, 2021). Such examples exist in the same region, such as renewable energy auction for utility-scale solar PV in Cambodia was down to 3.87 cents per kWh (ADB, 2019).

In addition, financial institutions and investors are increasingly moving away from coal and explicitly committing to divest from, ban or restrict financing of thermal coal, including 40 per cent of the top 100 global banks and 20 globally significant insurers (e.g., Norway's Sovereign Wealth Fund, World Bank, ING, Suncorp, Chubb, AXA and Zurich). This includes Asian financial institutions, including banks and insurers, that have recently joined an initiative of more than 100 significant financial institutions committing to strengthening policies to move away from thermal coal, including major Chinese and Japanese financial institutions (e.g., Asian Infrastructure investment Bank, Sumitomo Mitsui Trust Bank and Dai-ichi Life) (Buckley, 2019).

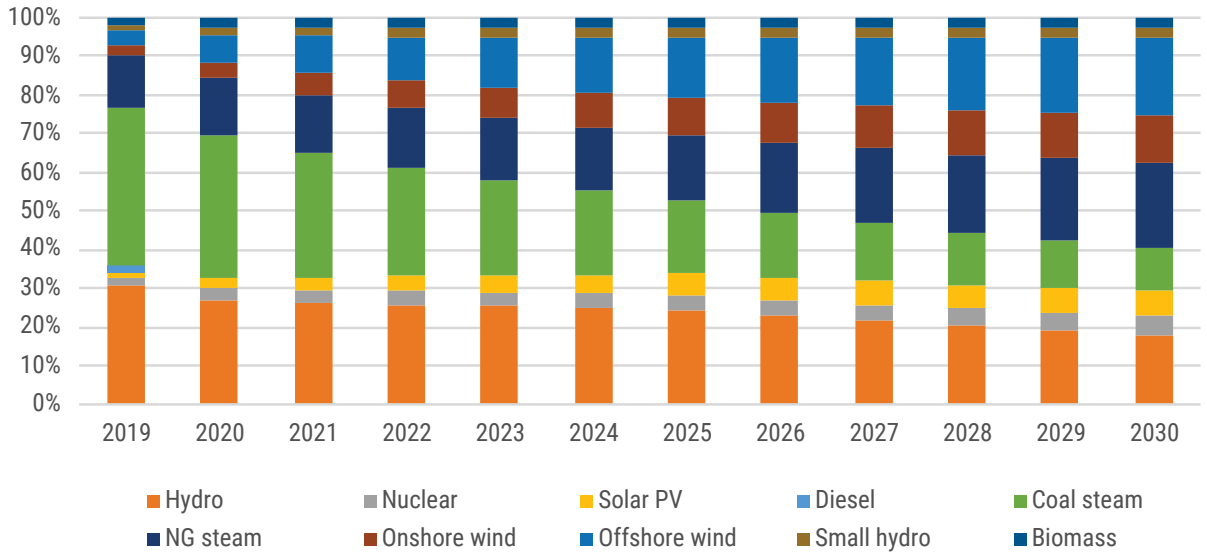
5.3. Power sector strategy

The implications have been modelled of a coal phase-out scenario in the power sector that has the following strategy:

- No new coal investment after 2020. However, it is estimated that by this time the capacity would have reached 20 GW, up from the 2018 capacity of 18.5 GW;
- Power generation by the existing coal power plants will gradually decrease to 50 per cent of its 2018 value in 2030. This is in line with the requirement of a complete phase-out by 2040 (as mentioned above).
- Power generation from coal would drop from 114 TWh in the base year to 57 TWh in 2030. The share of coal power generation will be reduced to 10.5 per cent in 2030.
- To meet the shortfall, a rapid increase in renewable energy technologies will be required, as follows:
  - Hydropower – increase to 25 GW in 2030;
  - Solar PV – increase to 20 GW in 2030;
  - Onshore wind – increase to 25 GW in 2030;
  - Offshore wind – the largest increase, from none in 2018 to 36 GW in 2030;
  - Small hydro and biomass – remain the same as in the SDG scenario at 4.4 GW and 2.4 GW, respectively.

It is important to note that this scenario sets the strategy for coal phase-out by 2040 as suggested under the Paris Agreement. A complete phase-out has not been covered in this roadmap as the analysis period is only to 2030; therefore, a halfway reduction has been modelled with an assumption that the other half would be implemented in the following decade (2031-2040). However, this appropriately sets the pathway for the coal phase-out. Figure 16 shows the generation mix in the coal phase-out scenario.

Figure 16. Generation mix in the coal phase out scenario



5.4. Managing the transition of the coal industry with 'just' transition

The coal industry in Viet Nam is more than a century old – the first coal-fired power plant was installed in 1894. The coal industry has grown substantially since then and contributes substantially to Viet Nam's economy, including by serving as a strong backbone of the power sector, supporting strong economic growth and creating jobs. Closing down such a strong industry is not an easy decision for policymakers, considering the fact that this industry is linked to a large number of jobs.

However, as with any technological transition, countries need to embrace changes. Given the substantial existing socio-economic structures that act as a major barrier to phasing out coal in Viet Nam, it is vital that the Government of Viet Nam works, with support from the international community, to develop and implement a "just transition" plan for coal-dependent regions affected by the phase-out. Energy transitions are about people – workers, consumers, businesses and communities – who make decisions that lead to transitions and are ultimately affected by them.

There are several examples in the world where such a transition has been very well managed. These examples include Australia's Latrobe Valley, Scotland's Just Transition Commission and Germany's Ruhr Valley and Lausitz/Lusatia, where an inclusive, iterative, place-based, context-specific approach enabled by public investment provided the best outcomes, including the creation of low-carbon employment alternatives. Based on internal experience of managing 'just' transition, the following are a few key recommendations:

1. Build a social compact between the key parties to manage the conflicts that can emerge during transition out of coal. Some countries, e.g., Canada, Scotland and South Africa, have commissioned 'just' transition commissions to manage this process;
2. An early closure plan will help minimize severe impacts in the long term. If the transition planning is delayed, labour markets may not be able to cope with the volume of displaced workers. Redeveloping the skills of the existing workforce to align with new technologies would be critical;
3. Establish funds and authority for a 'just' transition. Specialist funds are being established for overseeing, developing and implementing coal transition programmes. For example, the European Commission's Coal and Carbon-intensive Regions has launched the Just Transition Platform (JTP), with a more than Euro 150 million fund to be used in 13 coal regions across Europe to support the Just Transition (European Commission, 2020).

5.5. Policy recommendations

5.5.1. A combination of electric and LPG cooking stoves is a sustainable long-term solution with multi-fold benefits

A combination of electric and LPG cooking stoves is a prime solution for closing the remaining clean cooking gap. It serves as a long-term solution with a reduced burden on fuel imports. As discussed above, access to clean cooking fuels and technologies will pose even more challenges than before in achieving this last miles of connections. This is because there are two dimensions to the challenge:

a. Viet Nam needs to completely eliminate the use of the traditional biofuel cooking stove by 2030 and replace it with clean cooking fuels and technologies, which is likely to increase the use of LPG cooking stoves;
b. LPG in Viet Nam is imported and is susceptible to external price hikes and supply difficulties, and therefore should be reduced.

Based on this two-pronged challenge, this analysis suggests using a combination of LPG and electric cooking stoves. LPG cooking stoves can be used in remote rural areas where electricity may not be of high quality and/or reliable, while the remaining areas can use electric cooking stoves.

5.5.2. An intensified effort should be made to increase energy efficiency across different sectors

Energy efficiency is an important measure in reducing energy consumption in the energy sector and benefiting from lower investment in energy systems, low to no-cost actions and reduced energy-related emissions. Viet Nam has a large opportunity to further improve its energy efficiency, particularly in the industrial sector but also across other sectors. This analysis suggests that, in addition to the current programme aimed at reducing energy consumption by 10 to 15 per cent in some industrial subsectors, a mandatory 20 per cent efficiency improvement should be mandated across the entire industrial sector. This can also be mandated through energy improvements per sector. For the residential sector, this roadmap suggests further enhancement of the labelling and standards of household and commercial appliances and equipment, so that 30 per cent of all appliances are converted to efficient versions.

5.5.3. Reduce new investment in coal-fired power plants in order to achieve the national targets

Reducing the role of coal-based generation is important in achieving the NDC unconditional target. Viet Nam's plan to expand its coal-fired power station fleet will substantially increase emissions and present a barrier to achieving the NDC target, even the unconditional target. Gradually decreasing coal power plants, with a complete phase-out by 2040 in line with the requirement under the Paris Agreement, will require a further increase in renewable energy generation capacity to 83 GW (compared to 68 GW in the current plan) to generate 253.5 TWh by 2030. By doing so, Viet Nam will not only achieve the unconditional NDC target but also will increase the share of renewable energy in TFEC to 22 per cent.

5.5.4. Phasing out existing coal-fired power generation through 'just' transition

While coal has been the backbone of Viet Nam's power sector, it is appropriate to consider alternatives in future energy planning. This is not only because Viet Nam will miss out the NDC unconditional target (albeit a low target compared to other countries around the world – Indonesia aims to reduce by 29 per cent unconditionally) but coal-based generation is more expensive than its counterpart renewables. This gap will continue to widen as the costs of renewables decline further. As such, phasing out of coal has started globally – an increasing number of countries are announcing their coal phase-out plans. Estimates have suggested that in order to be in line with the Paris Agreement's temperature goals, the countries in Asia and the Pacific should: (a) stop investing in new coal generation after 2020; (b) reduce coal for power generation by 63 per cent below 2010 levels by 2030; and (c) achieve full phase-out by 2040 (UNESCAP 2021b). Viet Nam has made an encouraging announcement in COP 26 that the country will reach net zero carbon emissions by 2050. The Government has made a commitment

to stop deforestation by 2030 and to phase out coal-fuelled power generation by 2040 (Viet Nam Briefing, 2021).

It would be appropriate for Viet Nam to start preparing for coal phase-out by developing a comprehensive long-term strategy to minimize severe impacts to the economy. Experts (ILO, 2018) believe that if the transition starts early and is managed through 'just' transition, the socio-economic impact will be far less than it would be by not doing so.

5.6. Putting a price on carbon will help to reduce the investment gap

Carbon pricing is recognized around the world as an effective policy tool for facilitating sustainable energy transition. The external cost of carbon emissions such as health impacts, climate change and social costs paid by society should be shifted towards the producers and consumers responsible for producing pollution-causing goods, by directly setting a price on carbon emissions.

There are two main mechanisms for carbon pricing – emission trading schemes (cap and trade) and carbon taxation. Emission trading systems place a cap on CO_2-e emissions and allow participants to trade an allowance of CO_2-e emissions under the cap. The mechanism results in a wealth transfer from high-emission to low-emission technology proponents, increasing the attractiveness of low-emission technology investments.

Putting a price on carbon can significantly ease the burden of additional investment in transitioning to the coal phase-out scenario. An analysis has shown that the need for additional investment can be eliminated with a carbon price of US$20.2 per ton of CO_2-e. This estimate has been based on the additional investment of US$68 billion for transitioning to the coal phase-out scenario, compared to the current policy scenario. Fund-raising from the carbon price has been estimated by using the total CO_2-e emissions in the coal phase-out scenario (3,372 $MtCO_2$-e during 2019-2030).

6. Building back better in the recovery from COVID-19 with the SDG7 roadmap

Energy plays a key role in rebuilding better in the recovery from the COVID-19 pandemic. Energy services are essential to supporting health-care facilities, supplying clean water for essential hygiene, enabling communication and IT, and off-grid renewables refrigeration for vaccine storage. Economic challenges resulting from the pandemic have the potential to force countries in the Asia-Pacific region to focus on short-term fixes to revive GDP growth, potentially undermining long-term sustainable development. In the energy sector, this can result in the decline of investment in clean energy development – slowing progress on renewable energy and energy efficiency, and eventually, impeding national economic growth.

The COVID-19 pandemic has caused social and economic devastation globally as well as in Viet Nam, albeit less so than in other countries. Viet Nam's economic growth has contracted to 1.9 per cent growth, compared to its usual trend of 7 per cent. Nevertheless, the economy is projected to return to 6.5 per growth rate in 2021, according to the International Monetary Fund (IMF). This has been made possible due to strong economic fundamentals, decisive containment measures and well-targeted government support (Dabla-Norris and Zhang, 2021).

However, the tourism sector has suffered very much, as has the export sector. The international Labour Organization estimates that nearly 5 million people have lost their jobs (Tran and others, 2020). On its path to recovery, Viet Nam needs to ensure that all possible measures are taken to put the country on track and achieve an annual average GDP growth of 7 per cent.

Experts[8] believe that transitioning to a sustainable energy future, e.g., planning the energy sector in alignment with SDG 7, NDC and the Paris Agreement's long-term temperature goal, can help countries recover easily. Therefore, it has never been more important to design a well-planned energy transition pathway that enables Viet Nam's energy sector to shield itself from the likely impacts of the COVID-19 pandemic, and helps in the recovery to build back better. The SDG 7 roadmap has identified several key areas that will assist policymakers in strengthening policy measures to help recover from the COVID-19 impacts, while maintaining the momentum to achieving the 2030 Agenda for Sustainable Development and the Paris Agreement.

6.1. Accelerating access to clean and modern energy services

Access to clean and modern energy services is essential to helping rural populations to combat challenges related to COVID-19. Relying on traditional and hazardous technologies for cooking increases their susceptibility to the effects of the virus. It is important to consider how these seismic shifts in the energy sector from COVID-19 affect the most vulnerable people.

Viet Nam has about 7 million people who do not have access to clean cooking fuel. Access to clean cooking technologies is a development challenge that is often overlooked. WHO has warned about the severity of health impacts arising from the exposure to traditional use of biomass for cooking, and is encouraging policymakers to adopt measures to address this challenge. Moreover, scientists are investigating links between air pollution and higher levels of coronavirus mortality, with preliminary results showing a probable correlation between the two (Aarhus University, 2020).

The SDG 7 roadmap has analysed and identified technical options for connecting the remaining population to cleaner fuel for cooking, and has estimated the cost of the measure. The benefits resulting from this measure, in the form of reduced mortality and impacts on health, will exceed the needed investment to advance the clean cooking rate to 100 per cent.

6.2. Savings from the energy sector will help to build other sectors

The NEXSTEP analysis shows that there are ample opportunities for Viet Nam to save energy by improving energy efficiency beyond the current practices. Several of these measures also provide cost-savings and strengthen the country's energy security, making it less susceptible to fuel supply and price shocks. Savings from this improvement

8 See https://www.irena.org/-/media/Files/IRENA/Coalition-for-Action/Publication/IRENA_Coalition_COVID-19_response.pdf

can help gain investment in other sectors, such as health, social protection and stimulus, which are critical in responding to, and recovering from the COVID-19 pandemic.

The electrification of the transport sector, as highlighted in the SDG scenario, provides multiple related benefits (in addition to energy saving), including the reduction of expenditure on importing petroleum products and reduced local air pollution. In addition, reducing coal burning and increasing renewables in the power sector will further improve public health and local environments as well as bring positive economic returns.

6.3. Restructuring fiscal measures to invest where it is needed the most

Fossil fuel subsidies are often used by Governments to increase the affordability of energy services for the poor. Unfortunately, this supports the rich more than its intended target group because it is the more affluent segment of the population who use more energy than the poor. The annual expenditure on fossil fuel subsidies is in the range of US$260 million per year, which is very significant and will impede the investment needed in the critical sectors such as health care.

In some cases, subsidies are poorly targeted and thus lead to unintended consequences, and do not reach the targeted segment of the population. In addition, the fossil fuel industry has been the major source of air pollution, causing severe health impacts, which is likely to increase the vulnerability of people to pandemics such as COVID-19. Renewable energy technologies have multiple benefits – including improving health, increasing energy security by utilizing indigenous energy sources, reducing import costs of feedstocks and technologies, and enhancing natural capital. While the cost of renewables has decreased significantly and their LCOEs are already cheaper than their fossil fuel counterparts, the importance of putting a price on carbon should not be ruled out. The additional funds generated with such a fiscal instrument can be used to level the playing field for renewables as well as support economic recovery in cases like COVID-19.

7. Conclusion

The 2030 Agenda for Sustainable Development and Paris Agreement provide a common agenda for all countries to achieve sustainability and climate objectives. Achieving the SDG 7 and NDC targets is not an easy feat, but it will help to create a more sustainable and resilient society. This roadmap has presented a number of different scenarios together with their technical feasibility, investments, benefits, challenges and opportunities to inform policymakers of different pathways to energy transition. One scenario looked beyond just achieving SDG 7 targets and explored the full potential of the country in relation to reducing coal-fired power generation in line with the global call for coal phase-out.

Viet Nam is assumed to have achieved universal access to electricity in 2021. However, there is no specific policy or programme in relation to clean cooking. This has left more than a quarter of the population relying on traditional biomass cooking stoves. Based on the cost evaluation of different cooking technologies, considering the locations of some of the unconnected households and the fact that LPG is an imported fuel in Viet Nam, this roadmap suggests using a combination of electric and LPG cooking stoves to achieve universal access by 2030. Of the remaining two million households, electric cooking stoves should be encouraged for those with more reliable electricity supply, while the remainder can use LPG cooking stoves.

Energy efficiency improvement in Viet Nam during the past three decades has been low at 0.9 per cent annual improvement compared to the global rate of 1.5 per cent. This indicates that Viet Nam has substantial opportunities to improve its energy efficiency. Although the Viet Nam National Energy Efficiency Program (VNEEP) has been in place for many years, it will not be able to achieve the energy efficiency target for SDG 7. This roadmap suggests enhancing the VNEEP programme to ensure by 2030 that 30 per cent of appliances in the residential and commercial sectors are efficient versions, a 20 per cent mandate of industrial energy efficiency by 2030 and 30 per cent electric vehicle penetration by 2030.

The current NDC unconditional target (5.5 per cent reduction for the energy sector) of Viet Nam is a relatively low target when compared to other countries in the region as well as globally. By increasing efforts to improve energy efficiency and stopping new investment in coal after 2022, Viet Nam would not only achieve the NDC unconditional target but also would be able to enhance its NDC target (for the energy sector) to a 25 per cent reduction.

Viet Nam's power sector has been largely reliant on coal, which will be further expanded in the current policy scenario. However, coal-based power generation is not only hazardous for the environment and public health, but is also uneconomic in the long term. More than 80 per cent of the emissions from the power sector is from coal burning, and it is the main obstacle for Viet Nam in achieving its NDC target. Furthermore, there are global calls for phasing out coal, suggesting that countries in the Asia-Pacific region phase out coal by 2040. With regard to technology, with its very large untapped renewable energy resources, Viet Nam is very well-positioned to limit the use of coal in power generation. Policymakers need to start the transition plan early by consulting with stakeholders and international communities in order to develop a 'just' transition plan. If the coal phase-out plan is implemented, Viet Nam would be in a position to enhance its NDC conditional target (for the energy sector) from the current 16.7 per cent to 40 per cent.

Finally, the energy transition pathway presented in this SDG 7 roadmap will support building back better after the COVID-19 pandemic. The proposed energy transition presents opportunities to reduce economic risks, both for public and private investments, and identifies areas for financial savings in the energy sector that can support the recovery of other critical sectors, such as the health sector.

References

Aarhus University. 2020. "Link between Air Pollution and Coronavirus Mortality in Italy Could Be Possible." ScienceDaily. April 2020. https://www.sciencedaily.com/releases/2020/04/200406100824.htm.

ADB (2019). ADB-Supported solar project in Cambodia achieves lowest-ever tariff in ASEAN. Manila: Asian Development Bank. 5 September 2019. Available at https://www.adb.org/news/adb-supported-solar-project-cambodia-achieves-lowest-ever-tariff-asean

Alcorta, L., M, Bazilian, G, De Simone and A. Pedersen (2014). Return on investment from industrial energy efficiency: Evidence from developing countries. *Energy Efficiency*, vol. 7, No. 1: pp. 43-53. Available at https://doi.org/10.1007/s12053-013-9198-6

Anh, P., Nguyen Thi Kim Ngan and Nguyen Thi Thuy Huong (2020). Vietnam's National Energy Development Strategy to 2030 and outlook to 2045. *International Journal of Economics & Business Administration (IJEBA)*, vol. VIII, No. 4: pp. 1023-1032.

Buckley, Tim, 2019, "Over 100 Global Financial Institutions Are Exiting Coal, With More to Come." Institute for Energy Economics and Financial Analysis, Report. http://ieefa.org/wp-content/uploads/2019/02/IEEFA-Report_100-and-counting_Coal-Exit_Feb-2019.pdf

Dabla-Norris, E. and Y. S. Zhang (2021). Vietnam: Successfully navigating the pandemic. Washington D.C.: International Monetary Fund. Available at https://www.imf.org/en/News/Articles/2021/03/09/na031021-vietnam-successfully-navigating-the-pandemic

EIA (2021). Vietnam's latest Power Development Plan focuses on expanding renewable sources. June 2021. Available at https://www.eia.gov/todayinenergy/detail.php?id=48176

ESCAP (2020). *Energy Transition Pathways for the 2030 Agenda: SDG7 Roadmap for Indonesia*. Available at https://www.unescap.org/resources/energy-transition-pathways-2030-agenda-sdg7-roadmap-indonesia

——— 2021a. Asia-Pacific Energy Portal. Available at http://asiapacificenergy.org/#en

——— (2021b). Coal Phase-out and Energy Transition Pathways for Asia and the Pacific. Available at https://www.unescap.org/kp/2021/coal-phase-out-and-energy-transition-pathways-asia-and-pacific

——— (2021c). Decision of the Prime Minister No. 428/QD-TTg of 2016 on the Approval of the Revised Nat https://policy.asiapacificenergy.org/node/2760ional Power Development Master Plan for the 2011-2020 Period with the Vision to 2030. Available at https://policy.asiapacificenergy.org/node/2760

ESMAP (2015). Multi-Tier Framework for Measuring Energy Access. Energy Sector Management Assistance Program. Washington D.C.: World Bank. Available at https://www.esmap.org/node/55526

European Commission (2020). Green Deal: Coal and other carbon-intensive regions and the Commission launch of the European Just Transition Platform. 26 June 2020. Brussels. Available at https://ec.europa.eu/commission/presscorner/detail/en/ip_20_1201

Government of Viet Nam (2020a). Updated Nationally Determined Contribution (NDC).

——— 2020b. National Program on EE 2019-2030." November 2020. Available at http://www.dataenergy.vn/d4/news/Chuong-trinh-quoc-gia-ve-SDNLTKHQ-2019-2030-8-1045.aspx

——— 2021. Viet Nam Government Portal. Available at http://chinhphu.vn/portal/page/portal/English/TheSocialistRepublicOfVietnam/AboutVietnam/AboutVietnamDetail?categoryId=10000103&articleId=10000505

IEA (2021). Viet Nam – Key Energy Statistics, 2018. Paris: International Energy Agency. Available at https://www.iea.org/countries/viet-nam

ILO (2018). *Just Transition Towards Environmentally Sustainable Economies and Societies for All*. Paris: International Labour Organization. Available at http://www.ilo.org/actrav/pubs/WCMS_647648/lang-en/index.htm

IRENA. (2021). Renewable Power Generation Costs in 2020. Lorimer, M. ad L. Doan (2021). Vietnam's Draft Master Plan VIII – what it means for renewable energy." Watson Farley & Williams. 6 April 2021. Available at https://www.wfw.com/articles/vietnams-draft-master-plan-viii-what-it-means-for-renewable-energy/

Teske, S., T. Morris, K. Nagrath and E. Dominish (2019). Renewable Energy for Viet Nam – a Proposal for an Economically and Environmentally Sustainable 8th Power Development Plan for the Viet Nam Government, 2019. Available at https://www.uts.edu.au/sites/default/files/article/downloads/Teske-Morris-Nagrath-2019-Renewable-Energy-for-Viet-Nam-report.pdf

Tran, Bach Xuan and others (2020). Impact of COVID-19 on economic well-being and quality of life of the Vietnamese during the National Social Distancing. *Frontiers in Psychology*, vol. 11. Available at https://doi.org/10.3389/fpsyg.2020.565153

Tuyet Hanh and others (2020). Vietnam climate change and health vulnerability and adaptation assessment, 2018. *Environmental Health Insights*, vol. 14. Available at https://doi.org/10.1177/1178630220924658

Viet Nam Briefing (2021). COP26: Vietnam's commitment to reducing emissions. 5 November. Available at https://www.vietnam-briefing.com/news/cop26-climate-change-vietnams-commitment-reducing-emissions.html/

World Bank (2021). World Bank Country and Lending Groups. Available at https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups

Yeap, J.. 2021. Vietnam's power plan will need investment of $320.6bn. London: Pinsent Masons. Available at https://www.pinsentmasons.com/out-law/news/vietnams-power-plan-will-need-investment-of-$320_6bn