Towards a Socially Just Energy Transition in Viet Nam

Challenges and Opportunities

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FRIEDRICH EBERT STIFTUNG

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Abbreviations

ASES	Advanced Sustainable Energy Scenario
AECID	Spanish Agency for International Development Cooperation *Agencia Española de Cooperación Internacional para el Desarrollo*
AQI	Air quality index
BAU	Business As Usual
BKU	Ho Chi Minh City University of Technology *Bach Khoa University*
BOT	Build, operate and transfer
CFL	Compact fluorescent lamp
CIEM	Central Institute for Economic Management
EE	Energy efficiency
ERAV	Electricity Regulatory Authority of Viet Nam
EuroCham	European Chamber of Commerce
EVN	Electricity Viet Nam
EVN CPC	EVN Central Power Corporation
FDI	Foreign direct investment
FES	Friedrich-Ebert-Stiftung
FiT	Feed-in tariff
GDP	Gross domestic product
GHG	Greenhouse gas
GIZ	German international development gency *Gesellschaft für Internationale Zusammenarbeit*
HCMC	Ho Chi Minh City
HUST	Hanoi University of Science and Technology
IOE	Institute of Energy
IBT	Incremental block tariff (scheme)
INDC	Intended Nationally Determined Contribution
IPP	Independent power producer
JSC	Joint stock company (in Viet Nam: a company with three or more shareholders)
KfW	German government-owned development bank Name was originally from the German *Kreditanstalt für Wiederaufbau* (Reconstruction Credit Institute)
kWh	Kilowatt hours
LCOE	Levelized Costs Of Electricity
LEP	Local energy planning
LULUCF	Land use, land-use change and forestry
MtCO2e	Metric tonnes of carbon dioxide equivalent
MARD	Ministry of Agriculture and Rural Development
MOC	Ministry of Construction
MOF	Ministry of Finance
MOIT	Ministry of Industry and Trade
MOLISA	Ministry of Labour, Invalids and Social Affairs
MONRE	Ministry of Natural Resources and Environment
MOT	Ministry of Transport
MPI	Ministry of Planning and Investment
MW	Megawatt
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
NLDC	National Load Dispatch Centre
NPT	National Power Transmission Corporation
ODA	Official development assistance
O&M	Operation and maintenance
PC	Power corporation (power distributors)
PDP7-revised	Revised version of Viet Nam's seventh Power Development Plan
PPA	Power purchase agreement
PV	Photovoltaic
PVN	PetroVietnam National Oil and Gas Group

RE	Renewable energy
REDS	Renewable Energy Development Strategy
SES	Sustainable Energy Scenario
SMEs	Small and medium enterprises
SNV	Netherlands Development Organisation Name was originally from the Dutch *Stichting Nederlandse Vrijwilligers* (Foundation of Netherlands Volunteers)
SoEs	State-owned enterprise
SR Viet Nam	Socialist Republic of Viet Nam
TOE	tonnes of oil equivalent
TWh	terawatt hours
UNDP	United Nations Development Programme
UNFCCC	United Nations Framework Convention on Climate Change
VBF	Viet Nam Business Forum
VCCI	Viet Nam Chamber of Commerce & Industry
VEA	Viet Nam Energy Association
VEPF	Viet Nam Environmental Protection Fund
VEPG	Viet Nam Energy Partnership Group
VINACOMIN	Viet Nam Coal - Mineral Industries holding corporation
VNEEP	Viet Nam Energy Efficiency Programme
VSEA	Viet Nam Sustainable Energy Alliance
VUSTA	Viet Nam Union of Science and Technology Associations
VWEM	Viet Nam Wholesale Electricity Market
W	Watt
WWF	World Wildlife Fund

Foreword

Tackling climate change will not be possible without a significant contribution from Asia. According to economic forecasts, Asia's share of global greenhouse gas emissions will grow dramatically in the coming decades due to increasing population rates and relatively robust economic growth. At the same time, millions of people in the region will be affected by climate change. Serious environmental pollution has resulted from the burning of fossil fuels. Health risks due to air pollution already affect millions of Asians.

There is growing interest in renewable energy in many parts of Asia as a result of energy security and environmental concerns and the need to deliver electricity to energy-poor regions. With dropping renewable energy prices, there is growing investment in the sector in Asia. This makes it increasingly possible to talk about the beginning of energy transitions in the region. Greater use of renewable energy may lead to more socially and environmentally just energy structures. We still know little, however, about the actual social and political contributions, costs and implications of renewable energy expansion.

Friedrich-Ebert-Stiftung has examined these questions with a series of country studies in Asia. The studies looked at the political and social factors that drive—but also hamper—socially just energy transitions. The authors of each case study in China, India, Indonesia, Japan, the Philippines, the Republic of Korea, Thailand and Vietnam worked with Miranda Schreurs, Professor of Environmental and Climate Policy in the Bavarian School of Public Policy, Technical University of Munich, to provide in-depth analysis of the situation in their respective countries. Julia Balanowski, a climate change consultant based in South-East Asia, supported the preparation of each country study and their review.

The country case studies provide insights into the status of climate and energy policies, their socio-economic implications and the actors involved in developing and implementing those policies. Two of the important questions that motivated this comparative study were: whether renewable energy development was contributing to a more socially just energy structure; and which factors foster and impede political acceptance of renewable energy development.

The Vietnamese case study was written by Dang Thi Thu Hoai and Koos Neefjes. It is based on an extensive review of the literature and media as well as numerous in-depth interviews with different stakeholders in the energy sector in Viet Nam. The study was also presented to an expert community for peer review. Further feedback was provided during a workshop in Hanoi in June 2017 when the draft version of the study was presented to a select group of experts. The resulting paper is a comprehensive, hands-on inventory of the current political economy of energy transition in Viet Nam.

Viet Nam, as one of the fastest-growing economies in South-East Asia, is undergoing rapid urbanization, industrialization and modernization. This situation offers a window of opportunity to consider the ways to realize a shift towards a less environmentally polluting and a more socially just energy structure. The starting point of this study is that greater use of renewable energy coupled with strengthened energy efficiency can improve the quality of energy services, create new jobs, and contribute to the modernization of industry, while also making a valuable contribution to climate change mitigation.

We hope that this study can help to achieve this aim by highlighting these opportunities and providing specific recommendations to overcome the challenges related to a transition towards a low-carbon future for Vietnam.

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September 2017

Acknowledgements

This paper is a part of the regional research initiative on socially just energy transitions in eight Asian countries supported by the Friedrich-Ebert-Stiftung (FES).

This paper on Viet Nam was written by Koos Neefjes of Climate Sense (Viet Nam) and Dang Thi Thu Hoai from the Central Institute for Economic Management (CIEM) in Hanoi.

The concept note and the overall FES project were initially the responsibility of Sonja Schirmbeck, and later managed by her successor Yvonne Blos, deputy resident director in Viet Nam and regional coordinator for climate and environment in Asia of FES. The project was further supported by Nguyen Hoang Ngan, Dang Thuy Duong and Julia Balanowski. The overall structure of country papers was formulated by Miranda Schreurs of the Bavarian School of Public Policy, at the Technical University of Munich. Their comments on various drafts of the Viet Nam paper were very helpful and highly appreciated.

The paper was informed by in-depth interviews with and written suggestions from officials, experts, entrepreneurs and non-governmental organization (NGO) staff. We gratefully acknowledge their support and insights, suggestions and information. They include: John Rockhold, ABBO and the American Chamber of Commerce; Tomaso Andreatta, the European Chamber of Commerce (EuroCham); solar power expert Trinh Quang Dung; Nguyen Hoang Dung, Power Engineering Consulting joint stock company 3; Dang Quoc Toan and Huynh Trung Hieu, Asia Petroleum Energy Corporation; Le Hoai Quoc, High Tech Park, Ho Chi Minh City; Nicolas Jallade, Artelia; Christoph Schill, EuroCham Green Growth Sector Committee, PRACSIS South East Asia; Bao Nguyen, Siam City Cement; Diep Bao Canh, RedSun; Gavin Smith, Dragon Capital; Manfred Otto, Duane Morris Viet Nam; Michael R. DiGregorio, Asia Foundation Viet Nam; Nguy Thi Khanh, GreenID; Daniel Plankermann, the German government-owned development bank KfW; Ingmar Stelter, Vu Chi Mai, Ly Thu Nga and Sebastian Homm, German international development agency (*Gesellschaft für Internationale Zusammenarbeit*, or GIZ) Viet Nam; Nguyen Tuan Anh, Ministry of Planning and Investment (MPI); Pham Van Tan, Ministry of Natural Resources and Environment (MONRE); Pham Cam Nhung, World Wildlife Fund (WWF) Viet Nam; Nguyen Quoc Khanh, energy expert; and Nguyen Duc Song, Institute of Energy.

Peer reviews and written comments on the draft paper and feedback on stakeholders in the energy sector were provided by several of the above, as well as by: Le Anh Tuan, Research Institute for Climate Change, Can Tho University; Nguyen Anh Tuan, Institute of Energy; Vu Xuan Nguyet Hong, formerly of CIEM; Nguyen Manh Hai, CIEM; Bastiaan Teune, Netherlands Development Organisation SNV; and Geert Vansintjan, Embassy of Belgium.

The draft summary was presented to a technical workshop organized by FES-Viet Nam and CIEM with the participation of representatives of business organizations, development partners, NGOs, and research organizations. All contributions made by participants were very much appreciated.

We apologize in case we have omitted any person's contribution in these acknowledgements.

Errors, misrepresentations or opinions expressed in this paper are the responsibility of the authors alone, and not of any of the interviewees, commentators or managers of the project.

I. Background

I.1 Viet Nam, energy and climate change

Viet Nam's rapidly growing economy is comparatively energy intensive and increasingly dependent on fossil-fuel consumption. Most households have access to electricity and other forms of energy, but deployment of non-hydro renewable energy is still limited. Viet Nam is very vulnerable to climate change and is targeting greenhouse gas (GHG) emissions reduction as part of its international climate change commitments. The commitments it has made for the energy sector are, however, rather low. This study examines whether energy transformation in Viet Nam can be socially and politically accepted, and provides recommendations on how it can be realized.

Viet Nam's energy sector is led by the Ministry of Industry and Trade (MOIT) and dominated by large State-owned Enterprises (SoEs), such as Electricity Viet Nam (EVN), VINACOMIN (coal mining and trade), the Viet Nam Oil and Gas Group (PetroViet Nam, or PVN) and the Viet Nam Petroleum Group (Petrolimex).[1] These SoEs jointly control most power generation and distribution as well as coal mining, import, export and distribution, and oil and gas exploration, refinement, import, export and product distribution. They have played a central role in national development, transport and industry, and the well-being of consumers. Some of their profits are transferred to the State as revenue, so they also support the activities of the central Government, which controls them. Core energy policy questions are debated in the National Assembly. Some SoE investments require approval by local authorities and may be discussed in the province-level People's Councils. The SoEs and their numerous subsidiaries are generally not subject to public shareholder meetings. They are opaque: citizens, media or researchers have little insight into SoEs' operations, investments, profits and losses, environmental performance or adherence to labour standards. Compliance by SoEs in the energy sector with disclosure regulation is weak.[2]

The prices of fossil fuels and electricity are subject to government control, although some competition does take place, for example between different power generation companies (wholesale) and between the various distributors of petroleum products and gas (retail). Complex formulae are used to arrive at official prices, linked to the movements fossil fuel prices on the world markets. Import, value-added, and environmental taxes are low. A price stabilization fund was set up for petroleum products to smooth the effects of global market fluctuations on domestic consumers, though with limited success.[3] Increases in wholesale or retail (ceiling) prices, including feed-in-tariffs (FiTs) for different forms of renewable electricity, are not subject to consultation with consumers or businesses, but are proposed by SoEs such as EVN or other government departments, then approved by a minister or the prime minister, and announced through the media. Comments or disagreements with price increases have been voiced primarily through social media and sometimes the public media.

Viet Nam is particularly vulnerable to the effects of climate change. It ranks eighth in the world according to the Global Climate Risk Index, which is based on the cost in human lives and gross domestic product (GDP) losses from climate extremes over the past 20 years.[4] Vietnamese scientists have observed climatic changes over the past decades, including increased average and heavy rainfall, sea-level rise causing increased saline water intrusion and more extreme storm surges, fewer but more severe typhoons, more severe droughts, and increased average temperatures and heatwaves.[5] Based on global circulation models, scientists predict these effects to intensify through the 21st Century.[6] The social and economic costs of climate change could be enormous, but early and well prioritized adaptation investment can prevent major losses, and would be an economically sound investment.[7] Viet Nam needs to adapt to the inevitable effects of climate change and has developed a great interest in its own mitigation of climate change.

Viet Nam has developed a comprehensive set of policies to respond to climate change. Climate change is addressed in the Law on Environmental Protection, in the Law on Hydro-meteorology and in the Law on Disaster Risk

Management. The national Climate Change Strategy and the Green Growth Strategy are particularly important for setting overall directions. There are numerous social, economic and sectoral strategies and plans. The most significant of these for the mitigation of GHG emissions are the ones on renewable energy and forestry. Viet Nam issued its Intended Nationally Determined Contribution (INDC) to the United Nations Framework Convention on Climate Change (UNFCCC) in late 2015 and issued its approval of the Paris Agreement under the UNFCCC on 3 November 2016, after which the INDC became its NDC (see section I.5 for details).[8] The Government also issued a plan for the implementation of the Paris Agreement,[9] which demonstrates its strong political backing of the initiative.

Viet Nam has the margin to improve its energy efficiency substantially, and it has potential for many forms of renewable energy. It also has some potential for small and medium hydro-power, but there are major problems associated with existing and new dams on the main rivers in Viet Nam and in the other riparian countries of the Red River and the Mekong River. In addition to producing power, dams can control floods in the rainy season and dispense water in the dry season. But their ability to regulate river flow is being challenged by the increasing extremes of the wet and dry seasons, and this function is drawing more of the dams' resources away from power production. Therefore, increasing the deployment of solar and wind energy, both current at near-zero levels, must be at the core of a transition towards a low carbon economy. In addition, Viet Nam is doing well on electricity access for the large majority of households and there are successes with digesters producing biogas for cooking. But many poor households in rural areas still lack either energy source and cook with traditional biomass, facing high indoor pollution levels. An energy transition must be socially just, meaning the poorest and most vulnerable must benefit from a shift to higher energy efficiency and renewable energy, and see their access to energy services increased.

This study (a) examines whether an energy transformation towards greater energy efficiency and a high share of renewable energy can be socially and politically accepted and realized in Viet Nam, (b) provides recommendations on how a socially just energy transition can be realized, and (c) explores which main change agents the Friedrich-Ebert-Stiftung (FES) and other agencies should work with to achieve this.

The paper is based on an extensive review of literature and media reports. In addition, informal, in-depth interviews were held with 18 stakeholder representatives, consisting of officials, independent experts, staff and managers of state-owned and private enterprises, international donor agencies, and NGOs. Drafts of this paper were peer reviewed and discussed in a workshop with several stakeholders.

I.2 Renewable energy in Viet Nam

Hydro-power makes up a substantial share of Viet Nam's electricity mix, and includes small and medium plants. Solar water heaters are quite common throughout the country and biogas digesters have spread fairly widely in rural areas. There are some factories producing electricity from waste or using biogas or biomass for heating and drying, and there is some production of biofuel (ethanol and bio-diesel). The potential to expand small, medium and large hydro-power is very limited but there is substantial potential for expansion of waste-to-energy and biofuel production. Viet Nam has near-zero deployment of wind or solar Photovoltaic (PV) power generation, despite considerable potential, and no concentrating solar power, geo-thermal power generation or tidal power generation.

"The most widespread explanation of Viet Nam's comparatively slow adoption of non-hydro renewable energy attributes it to vested interests".[10] Who supports and who opposes deployment of renewable energy in Viet Nam, and why, is presented in outline here. The views and the agency or influence of the various stakeholders are discussed in more detail in sections II.2, II.4, III.1 and III.2.

Renewable energy policy is set by the MOIT, which led the formulation of the Renewable Energy Development Strategy (REDS) and was drafting the Renewable Energy Action Plan as of mid-2017.[11] The REDS is mainly about power and heat generation, and biofuel production. Renewable power generation is the most significant of those three categories (hydro-electricity) and has the greatest potential (solar, wind and biofuel

based power). In rural areas, cooking and heating still use large amounts of biomass, and the use of biogas is being encouraged by some development programs. The use of natural gas is increasing and is already very common in urban areas, where low-income households may also use coal briquettes. Solar water heaters at the household level can receive a small subsidy, and have also spread throughout the country. Biomass, including agricultural residue, is increasingly used for industrial heating. Biofuel is being promoted in transport (e.g. ethanol mixed into petrol). The MOIT participated in the formulation of Viet Nam's NDC, is represented on Viet Nam's international climate negotiation team, and is fully aware of the importance of the energy sector for climate change mitigation.

However, and as explained in section I.1, the energy sector's contribution towards the overall NDC mitigation target is unambitious even though its emissions of GHGs are the largest in the country and increasing fast.[12] Viet Nam also has the possibility of using its agricultural by-products and industrial waste for sustainable energy.

Viet Nam's energy policies, including for renewables, are developed by MOIT. SoEs are responsible primarily for implementing policy, but they also influence it. For example, in 2016 the board of directors of the EVN issued a resolution on development of solar power, prioritizing sites of existing power plants where there are already transmission lines and other infrastructure and capacities, such as hydro-power reservoirs with the possibility for floating solar PV panels.[13] This resolution was issued before the final decision by the Government on the support policy for solar PV.[14] SoEs may have had an impact on this policy through inputs such as participation in consultation meetings on drafts, and through informal connections, of which there are many. For example, staff often come from the same colleges and universities, with some spending part of their career in a government unit and part working for a SoE.

Very little public consultation takes place apart from mandatory posting on the internet of final drafts for comments just prior to the approval stage of strategies, plans and other policies. Viet Nam has also embarked on power-sector reform, with the Electricity Law in 2004 aiming "to raise efficiency in electricity activities". This complex, two-decade process has created some competition in the wholesale power market, although this remains dominated by companies that belong to SoEs, and EVN still is the largest single buyer. On the retail side, fully competitive markets are expected to be achieved by 2024. This reform process is managed by experts and includes many central government decisions, with limited public consultation about advantages and disadvantages. But this reform process does not aim at an energy transition, and it is unclear how recent renewable energy targets might be hindered or enabled by the planned power-sector liberalization.

The power-sector reform process receives little attention in the national media, as it is a complex topic which has not yet directly affected customers.[15] In contrast, the public media pay substantial attention to renewable energy. They explain the advantages of household-level solar PV systems with net metering arrangements, as well as preliminary investment plans for solar PV or wind-powered electricity generation by national and international companies.[16] The media also occasionally report on investments in renewable energy and equipment manufacturing in Viet Nam. (Box 1, Box 2 and Box 3).[17]

The media also report on cases and allegations of misconduct by officials, collusion and corruption, which can also involve investors in renewable energy. This was shown by a report on gifts of luxury cars to provinces by Cong Ly ltd., the investment-owner of Viet Nam's largest wind park (see Box 1). There are also regular reports about barriers to projects, such as the relatively low FiT for wind and biomass-based electricity (SR Viet Nam, 2011a; SR Viet Nam, 2014b),[18] slow and inadequate technical regulation such as the standardized PPAs, and gaps in regulation. As an example of the latter, a policy was issued in April 2017 applying an FiT of 9.35 US$ cents/kWh for solar PV, but specific technical and administrative regulations for solar PV power plants and rooftop-mounted systems are yet to be issued (SR Viet Nam, 2017b). Regarding the wind parks in Box 1, Cong Ly is now receiving an FiT of 9.8 US$ cent/kWh for its off-shore wind turbines, while Tuy Phong and Phu Lac 1 receive the standard FiT of 7.8 US$ cent/kWh, of which EVN receives 1 US$ cent/kWh from the Viet Nam Environmental Protection Fund (VEPF). This FiT for wind power is under review but a new FiT had not been issued as of early May 2017.

Box 1. Examples of wind power generation in Viet Nam

EVN has signed a reported nine wind power projects with power purchase agreements (PPAs), with a total capacity of 404 megawatts (MW). Only five were in operation as of mid-2017:[21]

The Tuy Phong wind farm in Binh Thuan province was the first wind farm in Viet Nam to start operations, in 2012. It was developed by Renewable Energy Viet Nam (REVN), a private company. It has 20 turbines with a total of 30 MW installed capacity. Turbines were manufactured and installed by Fuhrlaender (Germany) and wind towers were manufactured by UBI (Viet Nam). Total investment was US$52 million, including REVN equity and a loan from the Viet Nam Bank for Agriculture and Rural Development (Agribank) guaranteed by Landesbank Baden-Wuerttemberg (Germany).[22]

The Phu Quy Wind Farm (6 MW) on Phu Quy Island, about 75 km off mainland Binh Thuan province, began operation in January 2013. It was developed by the Power Corporation of the Viet Nam National Oil and Gas Group (PetroVietnam, or PVN). It forms a hybrid system with diesel generation, serving the 27,000 inhabitants of the island.

The Bac Lieu province wind farm of Cong Ly ltd. is located in a tidal, near-shore location in Vinh Trach Dong commune. It has an installed capacity of nearly 100 MW with 62 wind turbines of 1.6 MW from General Electric (GE) (United States). The wind towers are from CS Wind (Viet Nam). The final phase, expanding the wind park to a full capacity of 142 MW, is expected to be completed by 2018. Total investment is estimated at US$260 million, financed by the Viet Nam Development Bank, backed up by credit from the Export-Import Bank of the United States.[23]

The Phu Lac 1 wind farm in Binh Thuan province was completed in 2016. This has a capacity of 24 MW, with 12 turbines manufactured by Vestas (Denmark) and wind towers from CS Wind (Viet Nam). It is owned and operated by Thuan Binh Wind Power joint stock company (JSC), a joint venture of 75 per cent investment by subsidiaries of EVN and 25 per cent private investment, with a total of nearly US$50 million investment including a loan of US$37 million from the German Development Bank KfW.[24]

The Blue Circle from Singapore and TSV, a private Vietnamese company, have together started construction of the Dam Nai wind park in Ninh Thuan province, with a 40 MW capacity and reported investment of US$80 million. It will be the first foreign-owned wind park investment, with Singapore-based Armstrong Asset Management as a shareholder and investor, and Gamesa (Spain) as equipment supplier, with 16 turbines each with 2.5 MW capacity.[25]

Renewable energy, including small and medium hydro-power and biofuels, is often presented positively in media reports because of its green and clean properties. This is contrasted with the pollution associated with the growing use of fossil fuels. Public debate on pollution scandals, renewable energy and climate change happens in workshops (sometimes reported in public media), research gatherings and informal settings. International development agencies and national and international NGOs drive some of those debates with research reports and policy recommendations on green growth, fossil fuel subsidies and renewable energy.[19] Debate takes place within the circle of energy professionals, formally spearheaded by the VEA, as well as on its website and in its publications. Debates in workshops and public forums are also driven by enterprises gathered under the VBF (in partnership with the Government), the Viet Nam Chamber of Commerce and Industry, and international business associations such as EuroCham, who also publish position papers. The related workshops are mainly in Hanoi because much of this is policy-focused, although some workshops with businesses, researchers and some NGOs are in Ho Chi Minh City (HCMC). Workshops are less common elsewhere in the country.

Vietnamese NGOs have gained strength in recent years, accumulating community-based project experience and conducting research that has informed their contributions to media reports, workshops, exchanges on social media, and public policy. Many NGOs are registered under the Viet Nam Union of Science and Technology Associations (VUSTA, which has members throughout the country). Together with government organizations such as the Institute of Energy (under the MOIT), NGOs studied, reported on and organized workshops about the revisions of policies, such as the national Power Development Plan 7.[31] In this case, they aimed to increase public appreciation for a future with less fossil fuel-based electricity and more renewables.[32] Another notable initiative was the creation of the Viet Nam Sustainable Energy Alliance (VSEA), a collective of NGOs and experts. One of its activities consisted of a public statement on the revision of the Power Development Plan 7.[33] NGOs make direct links between energy development and national efforts to limit GHG emissions, as Vietnamese leaders,

Box 2. Renewable energy equipment manufacturers in Viet Nam

Vietnamese-owned and foreign-invested companies based in Viet Nam are manufacturing and assembling different components of solar PV systems as well as wind towers. They tend to be focused on exports although some equipment has been used in Viet Nam.[26]

The towers in some of the first wind farms in Viet Nam were manufactured by UBI (Viet Nam) and CS Wind (see Box 1). CS Wind Viet Nam is the main production facility of CS Wind, a South Korean group, and started operations in Ba Ria-Vung Tau province 2003. CS Wind Viet Nam currently claims a production capacity of 900 towers per year. Together with UBI and Chinese companies it has been accused of dumping on the US market by US manufacturers, but these charges were rejected by findings that indicated CS Wind and others are competitive manufacturers.

Solar BK is a Vietnamese company headquartered in Ho Chi Minh City (HCMC). It has its roots in the research community that in 1975 began studying and experimenting with wind, solar heating, and solar power. From 2009, Solar BK was contracted to install solar PV and wind-power generation as well as battery storage on Viet Nam's Spratly islands (Truong Sa). It started manufacturing solar PV cells and panels in 2012, and is aiming for a production capacity of 300 MW/year. It also has a manufacturing unit for solar water heaters. It supplied rooftop solar PV systems to the UN office in Hanoi and the office building of Bình Dương provincial authorities.

RedSun manufactures solar PV panels, with a production capacity of 12 MW/year. It was established in 2007 by New Era Technology Co. Ltd. Viet Nam, and the Energy Conservation Centre (ECC) of HCMC.

Canadian Solar has production facilities in Canada, China and in Hai Phong, Viet Nam, where it produces solar panels. It is NASDAQ-listed, has a global workforce of nearly 9,000 and an annual turnover of US$3.5 billion.

Boviet Solar Technology Co., based in Bac Giang province, focuses on PV cell and panel manufacturing. With a manufacturing plant area of 70,000 square metres, registered capital over US$50 million, 700 employees and 200 MW annual production capacity it claims to be the largest PV manufacturer in Viet Nam. The mother company is PV Powerway, a Chinese holding founded in 1987.

JA Solar is a leading Chinese manufacturer of solar cells and panels that turned over US$2.5 billion in 2015. It has started construction of a large plant in Bac Giang province for assembly of solar panels. The first-phase investment capital of US$320 million is set to rise to US$1 billion and the project is estimated to generate over 3,000 jobs.

In 2011 First Solar started construction of a large solar panel factory in Dong Nam Industrial Park in Cu Chi district of HCMC, with investment capital initially set to reach US$1.2 billion. After less than one year the construction was halted; but more than 100,000 square metres of factory buildings had been built for an estimated US$50 million. This investment is reported to have been taken over by another investor who wants to revive the project with its original objective of solar cell and panel production.

media and the public regularly discuss the comparatively severe impacts of climate change on Viet Nam.

These various research efforts, workshops and advocacy publications have hinted at the main barriers to renewable energy transition in Viet Nam. These barriers include vested interests in maintaining the currently planned path of strong growth in consumption of petroleum products for transport, and of coal and gas for electricity production. Many in influential positions consider that electricity demand growth cannot be satisfied by renewable energy. Another common argument is that renewable energy is intermittent and can cause instability of the grid. But these are among the national and international myths about renewable energy that have been frequently challenged, including in Viet Nam.[34] Additionally, private investors maintain that the FiTs offered for renewable electricity are not sufficient, and that the single-buyer status of the EVN poses a risk that it may not pay, not pay on time, or not pay for all the power delivered, despite signing PPAs. The reasons for a slow transition in Viet Nam and the opportunities for speeding up the transition are discussed in depth in sections II and III.

I.3 Energy production and consumption

Viet Nam has experienced rapid growth of energy demand. Total primary demand increased from 13.4 million tonnes of oil equivalent (TOE) in 1990 to 78.6 million TOE in 2015, or 7.3 per cent annual growth during 1990-2015. The primary energy production of Viet Nam increased from 13.9 million to 76 million TOE, growing 7.2 per cent annually during 1990-2015 (and Table 1).[35] Power demand increased by 12.3 per cent annually and the industry and residential sector consumed respectively, about 39 per cent and 33 per cent of total power demand.

Box 3. Examples of Solar PV Power Developments in Viet Nam

Some solar PV rooftop systems were connected to the national grid in Viet Nam as of mid-2017, despite the absence of relevant administrative and technical regulations. There are also some off-grid systems by and for foreign-invested businesses and for low-income households, often supported by international development projects. In addition, there are several hybrid mini-grid systems that include solar PV, and sometimes battery storage or other sources of energy, such as diesel generation. There are many plans for solar PV farms in the pipeline. The following are some examples:[27]

1. Grid-connected solar PV rooftop systems. (a) The National Conference Centre in Hanoi has a grid-connected solar PV system (154 kW) in its gardens. (b) The UN House in Hanoi has a grid-connected rooftop system with 110 kW installed capacity, generating an estimated 10 per cent of its annual electricity consumption. (c) The XP Power Factory in Binh Duong has a 40 kW system. (d) The Institute of Natural Resources and Environment of the Viet Nam National University in HCMC has a 42 KW system. (e)The Spanish Development Cooperation Agency AECID financed a 22 kW system on a roof of the MOIT in Hanoi. (f) The carport of the People's Committee office in District 2 and the Department of Science & Technology in District 3 in HCMC each have a 20 kW system. (g) Supermarket Big C in Dĩ An (Bình Dương province) has a 212 kW system.

2. Off-grid solar PV rooftop systems of FDI businesses. (a) The Intel Building, HCMC Hi-Tech Park, has a 220 kW system. (b) The DBW garment factory in Long Hau Industrial Park in Long An province has a 165 kW system.

3. Off-grid solar PV rooftop systems for households and mini-grids. (a) Solar BK under the project Light Up The Spratly Islands" has installed solar PV on the islands, known in Viet Nam as Truong Sa; these are hybrid mini-grid systems including battery storage. (b) AECID supported the Con Dao island grid with a solar PV system of 36 kW (Vu Quang Dang, 2015). (c) There is a hybrid 100 kW solar PV with 125 kW small hydro-power system in Trang commune of Mang Yang district, Gia Lai (EVN, 2016). (d) Small solar PV and diesel generation hybrid systems serve groups of households in: Kongu 2 village (Dak Ha district, Kon Tum province); Bạch Long Vĩ island (Hải Phòng), and Phú Quý island (Bình Thuận) (EVN, 2016). (e) South Korean official development assistance is providing off-grid solar PV systems to 1,230 households and 78 agencies in 40 border villages in Quang Binh province by 2017.[28]

4. A pipeline of plans for solar PV farms. (a) EVN Central Power Corporation is planning solar PV on and near hydro-power reservoirs including Phuoc Thai, Song Binh, Tri An, and Se San 4. (b) EVN Power Generation Company 1 (GenCo 1) is planning the lake-based Dong Nai 4 Solar Power Project (50 MW). (c) EVN GenCo 3 is planning two solar PV projects that will be combined with hi-tech agriculture in Phước Minh commune, Ninh Thuận province (350 MW total capacity).[29] (d) The Thien Tan group has plans and general permission to develop a 19.2 MW solar farm in Minh Duc commune, Quang Ngai province; and a 1,000 MW farm in five phases in Ninh Thuận province, both in international partnerships for financing and equipment supply.[30] (e) Solar Park Global (South Korea) is studying and seeking licences for investment in a partly floating solar PV farm in Ea Sup District, Daklak province. (f) Tuan An Group is hoping to complete a 12 MW project in Cam Ranh in 2017.

Table 1. Energy demand and production in Viet Nam, 2010-2015

Indicators	2010	2011	2012	2013	2014	2015
GDP annual growth (%)	6.4	6.2	5.3	5.4	6.0	6.7
GDP per capita (US$)	901	947	986	1,523	1,596	1,685
Total primary energy supply (kilo-tonne oil equivalent (KTOE))	57,023	57,073	57,855	59,203	64,797	70,588
Non-commercial energy as % of total primary energy	24.4	24.5	24.4	23.1	19.7	16.9
Total energy import as % of total primary supply	23.6	23.6	20.6	18.2	19.3	21.9
Total final energy consumption (KTOE)	47,445	48,485	49,134	50,606	52,248	54,080
Final energy consumption per capita (kilogramme oil equivalent (KgOE))	546	552	553	564	576	590
Electricity consumption per capita (kWh)	998	1,077	1,187	1,294	1,416	1,564
Electricity intensity (kWh/US$1,000)	748	769	813	850	887	929
Electricity sale annual growth (%)	14.5	10.5	11.4	9.3	11.6	11.7
Electricity consumption as % of total energy consumption	22.2	23.6	25.9	27.0	27.9	29.2

Source: Institute of Energy (IOE) 2016

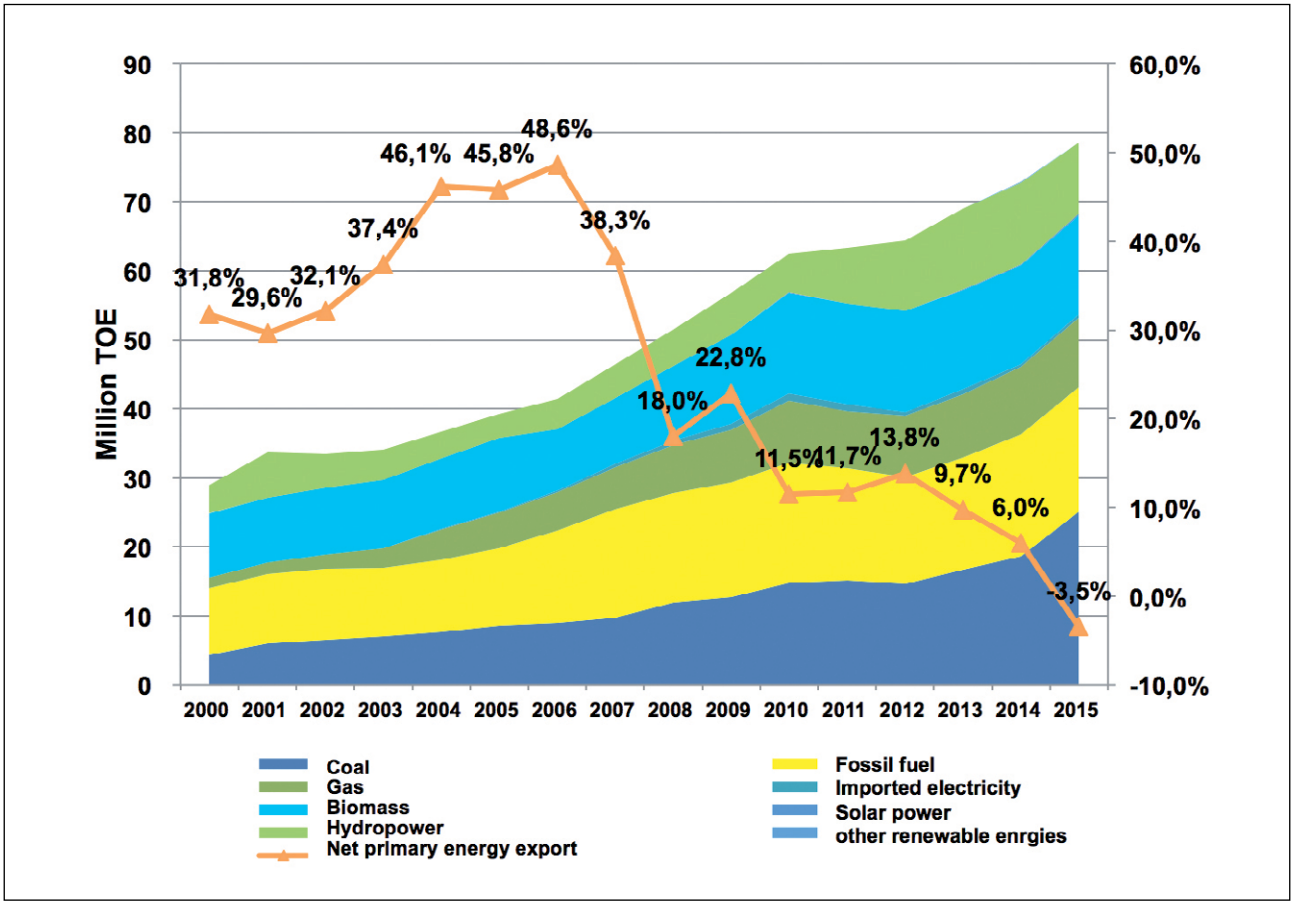

Figure 1. Primary energy consumption of Viet Nam 2000-2015.
Source: Nguyen Van Vy 2016.

Viet Nam has substantial proven reserves of fossil fuels, making it an important coal, oil, and natural gas producer.[36] However, the ratio of primary energy export to import steadily decreased from 48.6 per cent in 2006 to -3.5 per cent in 2015 (Figure 1). In other words, Viet Nam turned from a net primary energy exporter to a net importer in 2015. This trend is expected to continue and Viet Nam would reach a peak of 24.3 per cent net energy imports in 2030, which would then gradually decrease to 7.1 per cent in 2050 if there is a significant development of biomass, solar energy and nuclear power. However, in 2016 such development was postponed following debates in the National Assembly, making it more urgent to expand the potential role of renewable energy in meeting growing energy demand.

Table 1 shows that electricity intensity (the amount of electricity consumed per unit of GDP) increased during 2010-2015. Indeed, Viet Nam has the highest level of electricity intensity in South-East Asia.[37] Table 1 also shows that the annual electricity sale growth rate was almost double the annual GDP growth rate. It should be noted that the share of electricity in total energy consumption increased by roughly 5 per cent per year, partly as a result of energy substitution. Viet Nam's economy is thus following a high-energy development path, and it is not yet decoupling economic growth from energy consumption as it has been occurring in some other Asian countries.

The power generation structure will change significantly according to PDP7-revised.[38] Viet Nam's power sector has been dominated by hydro-power, and installed capacities of hydro-power would double from 2015 to 2030 according to the plan (see Table 2). The installed capacity of gas- and coal-fired power plants would increase more over this period. Renewable power installed capacity starts from near zero in 2015 and is expected to remain

Table 2. Total electricity generation installed and projected capacity in Viet Nam (PDP7-revised)

Capacity (MW)	2015	2020*	2030*
Gas- & oil-fired power	8,501	9,000	19,000
Coal-fired power	12,751	26,000	55,300
Nuclear power	0	0	4,600
Hydro power (small, medium, large)	16,075	21,600	27,800
Wind power	140	800	6,000
Solar	0	850	12,000
Other, including biomass & import	1,533	1,750	4,800
Total	**39,000**	**60,000**	**129,500**

*Source: Data for 2015 from: IOE 2016; SR Viet Nam 2016a (*projected)*

modest through 2030. Nuclear power was planned to have an installed generation capacity of 4,600 megawatts (MW) by 2030 but this plan was halted in 2016 after seven years of preparation. The cancellation of nuclear plans in Table 2 will have to be compensated by increasing the targets of the other sources.

In terms of actual power production, coal-fired power will make up to 53.2 per cent of the expected 572 terawatt hours (TWh) per year demand in 2030, according to PDP7-revised. This will require a significant increase in coal imports, to roughly half of all coal consumption for power. Hydro-power cannot remain dominant, partly because of environmental concerns. Its share in power production will likely fall from 34.3 per cent in 2015 to 12.4 per cent in 2030. The target share of renewable power production in PDP7-revised is 7 per cent in 2020 and 10 per cent in 2030, consisting of 2.5 per cent small hydro-power, 2.1 per cent biomass, 2.1 per cent wind and 3.3 per cent solar by 2030. According to the REDS, total power production would be 1,050 TWh/year by 2050, with a share of 43 per cent renewables, made up of 8 per cent biomass, 5 per cent wind, 20 per cent solar and 10 per cent small, medium and large hydro-power.[39]

There are several problems with these plans:

First, PDP7-revised may overestimate energy demand due to overly high projections of GDP growth rates and overly low projections of energy savings and efficiency improvements. According to one estimation, the total power demand in 2030 will be 407.7 TWh, which is much lower than the estimate by PDP7-revised.[40] And neither of those predictions consider a possible shift from fossil fuels for transport to electricity, which by 2030 could become significant as e-bikes are popular in Viet Nam and the global trend towards electric cars appears about to take off.

Second, there are doubts about the assessment of the potential for expansion of medium and large hydro-power as laid out in Table 2, while the targets for non-hydro renewable energy targets in PDP7-revised and the REDS seem to underestimate Viet Nam's potential. The technical potential of renewable energy for Viet Nam according to several sources is good,[41] but there are significant differences between theoretical and technical potential. Nevertheless, according to some observers, Viet Nam could aim for 100 per cent renewable energy even if demand increases, provided that efficiencies increase.[42] Recent high-quality mapping of the technical potential of solar power demonstrates a reasonable potential in the northern regions of Viet Nam (similar to Germany) and good to very good potential in the central and southern regions (similar to Spain).[43] These data can now be compared with a globally comprehensive and accessible high-quality database, which gives very similar results.[44] However, Viet Nam currently has only 160 MW of installed wind power and solar PV capacity, which would be the two primary technologies for non-hydro renewable power.

Third, Viet Nam has already taken some action to improve energy efficiency. The Viet Nam Energy Efficiency Program (VNEEP) was rolled out in 2006 with the aim of achieving an overall reduction of energy consumption by 3 per cent over the period 2006-10. But the energy efficiency potential is much larger, in particular in the industrial sector. Viet Nam's energy intensity is high compared with other developing countries (see above), and energy utility efficiency in coal and oil-power stations is only 28-32 per cent, which is 10 per cent lower than that of other developing countries. The main constraints include the low electricity tariff, lack of policy enforcement, and lack of financial mechanisms to support upfront investments in new technologies.[45] On the other hand, EVN claims significant efficiency improvements in power generation and supply, having reduced power losses from 10.15 per cent in 2010 to 7.94 per cent in 2015.[46]

Fourth, PDP7-revised proposes that shortages in the south and central areas of Viet Nam be covered by coal. By 2030, 14 coal-fired power plants are to be operational in the Mekong Delta, increasing total power generation capacity about 15 times. However, these plants cause air pollution and solid waste that may lead to social problems as well as global climate change, while the technology to capture and store carbon dioxide is expensive and unproven. In addition, coal plants consume vast amounts of water for cooling and steam production, which creates pressure on the water supply, as the Mekong Delta is already facing increased risks of drought, and groundwater mining is causing the soil to subside much faster than the sea level is rising. At the same time, the Mekong Delta and central region have the highest potential for wind and solar energy in Viet Nam.[47] It is argued that Viet Nam must first use this renewable energy potential before any further expansion of coal-fired power. As renewable power prices are falling fast they may now be competitive, whereas the expansion of coal power would introduce uncertainty and negative impacts.

I.4 Energy markets

Energy markets in Viet Nam are dominated by SoEs that hold near monopolies, notably EVN, PetroVietNam (PVN), Petrolimex and VINACOMIN. VINACOMIN has effective control over coal exploitation, production and trade. All the coal-mining companies are subsidiaries of VINACOMIN except a small number of private coal-mining companies which are licensed by provincial Departments of Planning and Investment.

The EVN group controls two thirds of total power generation capacity in Viet Nam. EVN partly manages power generation directly through its Central Power Corporation (CPC), and partly indirectly via three power generation companies (GenCo 1, 2 and 3) (see Figure 2). The remainder is owned by other SoEs, JSCs (some of which include SoEs as shareholders), and other domestic and foreign investors. The latter account for only a small share of the total power generation capacity. Furthermore, projects under the "Build Operate and Transfer" principle (BOT, see Figure 2), with international capital in which Vietnamese banks and SoEs may also participate, will in most cases be transferred to a EVN subsidiary at some point.

The Vietnamese Government wants to boost competitiveness in the power sector by implementing a roadmap on developing competitive power markets. This roadmap was initiated by the Law on Electricity in 2004 and follows the 2012 revision of this law and related documents.[48] This must deliver a fully competitive retail market by 2024, but currently distribution is fully controlled by state-owned corporations. The Viet Nam Wholesale Electricity Market (VWEM) was created in

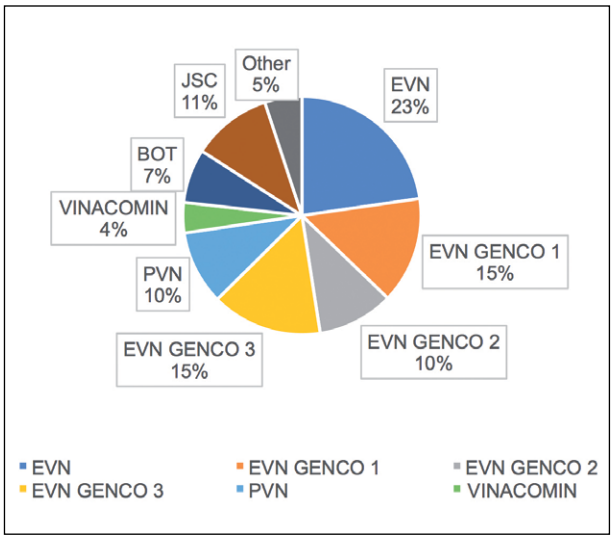

Figure 2. Share of power generation capacity in Viet Nam in 2015 by main investors.

Source: PV Power 2016.

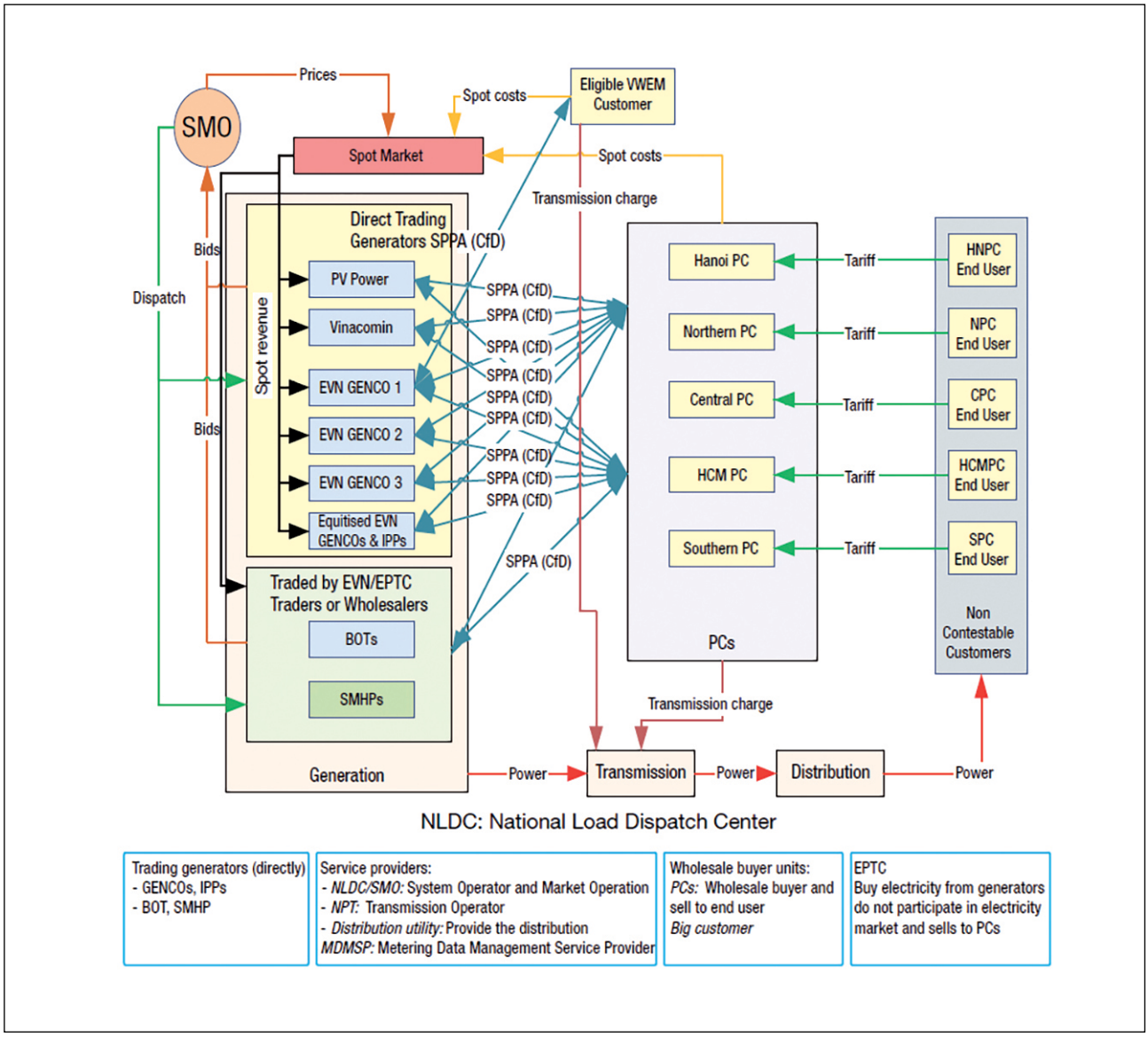

Figure 3. Structure of the Viet Nam wholesale electricity market (VWEM).
Source: EVN 2017.

2015 and the structure is shown in Figure 3. EVN owns the National Power Transmission (NPT) Corporation, which operates the national grid, and five Power Corporations (PC in Figure 3) responsible for distribution. EVN directly controls the National Load Dispatch Centre (NLDC) and the Electric Power Trading Company, which manage the amount of electricity supplied by GenCos, some against prices determined on the spot market.

The VWEM must make way for the Viet Nam Retail Electricity Market (VREM) from about 2021, but for now EVN's five PCs are effectively the combined single buyer in the wholesale market, and sell power to customers for strictly regulated prices. To make the wholesale and retail power markets competitive is challenging for many reasons:

- The power production units that fall directly under EVN make up its Central Power Corporation (EVN CPC). These and the three EVN GenCos are all owned by EVN. The GenCos are to be equitized but even then EVN will be the owner or majority shareholder and the mechanisms to guarantee their functional and financial independence are not yet clear.[49]

- The Electricity Regulatory Authority of Viet Nam (ERAV) and the National Competitiveness Council are both under the MOIT. The MOIT is the state representative/owner of EVN and the other energy SoEs, which account for most power generation. Independent Power Producers (IPPs) cannot compete healthily in this context unless all sorts of firewalls were set up and strictly enforced by ERAV, which is neither a fully independent nor a strong regulator.
- EVN subsidiaries are in charge of: market management; dispatching (NLDC); and transmitting electricity (NPT). Under this arrangement, it is not surprising that some IPPs find it difficult to get connected to the national grid and sell electricity to EVN PCs.
- Market entry for new investors is complicated. New power investment projects must be in the project list attached to PDP7-revised or get special permission from the MOIT. They need many other licences and a contract with the NPT for grid connection.

The transmission and distribution network includes 41,084 km of 500-220-110kV and 476,572 km of medium and low voltage lines.[50] Service quality has improved in recent years: the System Average Interruption Duration Index (SAIDI) fell from 8,077 minutes per customer per year in 2012 to 2,281 in 2015; the Average Interruption Frequency Index (SAIFI) fell from 39.24 times per customer per year in 2012 to 13.36 times in 2015; and the Momentary Average Interruption Frequency Index (MAIFI) dropped from 5.07 times per customer per year in 2012 to 2.03 times per customer in 2015.

The World Bank is supporting the government program on smart grid development, started in 2012, to improve grid reliability and manage power demand and supply more efficiently. This will benefit a transition towards more renewable energy in the power mix as well. EVN's NLDC and NPT are responsible for managing the implementation after measures are approved by ERAV. The World Bank has advised on different smart grid technologies to reduce operational expenditure, and reduce faults and repair time.[51]

The smart grid development roadmap is divided into stages, more or less in line with the power market roadmap:

(i) 2012-2016: Conduct a pilot project on the integration of renewable energy, including small hydro-power and other renewable energy, at EVN's Central Electricity Company.
(ii) 2017-2022: Develop policy packages to promote the development of a smart grid for renewable energy.
(iii) After 2022: Develop the smart grid to ensure a demand and supply balance, with renewables for the retail power market stage.

I.5 Energy policies

Section I.2 mentions some energy policies in Viet Nam in the context of a renewable energy transition. There are many relevant policies on energy and related matters, including laws, strategies, plans, circulars and technical regulations. The following are the most important ones.

Viet Nam has laws on oil and gas, electricity, atomic energy and energy efficiency.[52] The Law on Electricity initiated the ongoing power-sector reform process (see section I.2). The development of nuclear power as per the Law on Atomic Energy was put on hold in 2016, mainly on the grounds of costs in the context of high public debt. The National Assembly voted to support a government proposal in this regard.[53] The Law on Energy Efficiency is being implemented through a national programme that ended in 2015 but is expected to be renewed (see below).

Viet Nam also has a Law on Environmental Protection, which includes a chapter on climate change with provisions for the management of GHG emissions and renewable energy, and a Law on Environmental Protection Tax, which includes a list of fossil fuels that are subject to tax. Environmental taxes are still very low for petroleum products and negligible for coal.[54] An initial assessment showed that these taxes have had very limited negative impact on consumption, poverty levels and equality, and equally little positive impacts such as GHG emissions reduction.[55]

Different strategies and national programmes aim to implement key elements in the laws over given periods of time. The Viet Nam Energy Development

Strategy to 2020 and vision to 2050 covers all forms of energy; an update is being drafted in 2017.[56] In 2006, the National Target Program on Economical and Efficient Use of Energy (another name for the VNEEP) was approved, and it has been extended for 2012-2015. This aims to remove barriers to improving energy efficiency in enterprises, buildings, transport, services, and households, and the programme can claim some success.[57] The National Green Growth Strategy 2011-2020 with outlook to 2050 was issued in 2012. It includes a commitment to phasing out indirect subsidies on fossil fuels and encouraging renewable energy production and energy efficiency,[58] and lays out a roadmap.[59] Yet fossil fuel subsidies persist, because retail tariffs are low and have remained unchanged since 2015, despite inflation.[60] The Green Growth Action Plan translated the objectives of the Green Growth Strategy into a series of concrete, prioritized projects,[61] many of which are being implemented, although with some delays[62]. Many of these projects relate to energy and are regulated under sector policies such as the VNEEP. Examples include energy efficiency standards and energy efficiency labelling of equipment, transport-sector policies promoting increased use of biofuels, the issuing and enforcement of emission standards for transport, the development of public transport, and construction-sector policies such as enforcement of the Viet Nam Construction Code on "efficient and effective energy use in all construction works".[63]

The 2015 REDS is concerned with renewable power generation, biofuel production and heat generation.[64] It aims to increase domestic energy supply and the share of renewable energy, reduce dependency on fossil fuels and increase national energy security, and to mitigate GHG emissions and support environmental protection. It includes general provisions for stimulating the deployment of renewable energy, including favourable tax policies, a fee on the use of fossil fuels and the creation of a renewable energy development fund. It includes the following targets and projections:

- Increase the total production of renewable energy from 25 million TOE in 2015 to 37 million TOE in 2020, 62 million TOE in 2030 and 138 million TOE in 2050.
- The renewable energy share of total primary energy consumption is to drop slightly from 31.8 per cent in 2015 to 31 per cent in 2020, then increase to 32.3 per cent by 2030, and reach 44 per cent by 2050 (this projection includes large scale hydro-electricity developments and a high growth in total energy demand).
- Increase the absorption area of solar water-heating units (3 million m2 in 2015; 8 million m2 in 2020; 22 million m2 in 2030; and 41 million m2 in 2050).
- Scale up the application of biogas technologies (construction volume of 4 million m3 in 2015; 8 million m3 in 2020; 60 million m3 in 2030; and 100 million m3 in 2050).
- Increase the rate of households using high-performing stoves (negligible at present; 30 per cent in 2020; 60 per cent in 2025; and covering most rural households from 2030).
- Increase the production of biofuels for transport (from 150,000 TOE in 2015 to about 800,000 TOE in 2020 or 5 per cent of transport fuel demand; 3.7 million TOE or 13 per cent in 2030; and 10.5 million TOE or 25 per cent of the sector's demand in 2050).
- An increase in the proportion of domestically manufactured renewable energy equipment value from 30 per cent in 2020 to 60 per cent in 2030, and by 2050, domestic equipment production would essentially meet all domestic needs and leave a surplus for export.

The REDS does not address the electrification of transport, which could represent a major opportunity for substituting fossil fuel use for renewable power. It should also be noted that the REDS has not been operationalized yet, as the corresponding Renewable Energy Development Action Plan is still under development (see section I.2).

The targets for renewable electricity production in the REDS are similar to those in the PDP7-revised.[65] As per PDP7-revised, Viet Nam aims to increase renewable power production, but of the projected total power produced in 2030 of 506 TWh, less than 11 per cent would be from renewables (including small hydro), which seems unambitious. More than 53 per cent of electricity production would be from coal and nearly 17 per cent from natural gas fired power plants – the rest from large hydro, nuclear and imports. However, since this PDP7-revised was issued, the planned nearly 6 per cent nuclear power (by 2030) has been cancelled and would need to be produced by other means. Viet Nam is in mid-2017

still at near-zero solar PV and wind power deployment, and biomass and waste-based power deployment is also very modest (see section I.2). But according to the plans, installed capacity of solar PV would reach 850 MW in 2020, 4,000 MW in 2025 and 12,000 MW in 2030; and installed wind capacity would reach 800 MW in 2020, 2,000 MW in 2025 and 6,000 MW in 2030.[66]

At a more immediately practical level, policies include a decision on the avoided cost tariff for renewable power plants. The MOIT defines avoided cost as "the production cost per 1 kWh of the most expensive power generating unit in the national power grid, which would be avoided if the buyer purchases 1 kWh of electricity from a substitute small renewable energy power plant".[67] This policy covers small renewable power plants of less than 30 MW installed capacity and provides different types of renewable power as options. But it applies primarily to small hydro-electricity plants, one of the cheapest forms of power production. There are nearly 200 small hydro-power dams in Viet Nam which are currently the main source of renewable energy, but most potential is already being used and further expansion will be limited. This policy was replaced in 2014 with a MOIT circular on regulations for avoided cost tariffs and standardized PPAs for small hydro-power plants. The MOIT publishes the avoided cost tariffs annually,[68] with a fixed capacity charge covering investment costs and energy charges differentiated for different parts of the country, time of day (peak, normal, off-peak), and dry or rainy season. The average avoided cost tariff for small hydro-power plants has increased from 760 VND/kWh in 2009 to 1,069 VND/kWh (4.7 US$ cent/kWh) in 2016.[69] This is suitable for small hydro-power plants but does not follow the above-quoted definition of avoided cost.

The support policy on wind power set an FiT of 1,614 VND/kWh (fixed at 7.8 US$ cent/kWh) for a project lifetime of 20 years,[70] which is widely considered too low to transform the markets. The wind-power FiT has been under revision for some years but a revised, higher FiT has not been issued yet. On the other hand, Viet Nam's main offshore wind park receives a FiT of 9.8 US$ cent/kWh as per an ad hoc decision by the prime minister in July 2016 (see also section I.2). The wind power FiT includes 207 VND (1 US$ cent/kWh) that should be supplied by the VEPF, and to operationalize this, the Ministry of Finance (MOF) issued a circular on the financial mechanism to support the electricity price for grid connected wind power projects, as the VEPF would need to make payments.[71] However, this use of VEPF money has been criticized because of the VEPF's specifically environmental mandate and its occasional lack of resources, whereas EVN could absorb the FiT through cross-subsidies from cheaper forms of power in the national power mix, such as hydro-power. This is happening, for example, in the case of diesel generators that produce power for considerably higher costs, i.e. a levelized cost of electricity (LCOE) that may be 40 US$ cent/kWh or more.[72]

Similar support policies were issued for development of biomass power projects and waste-to-power projects.[73] For combined heat and power projects the biomass FiT was regulated at 1,220 VND/kWh (5.8 US$ cent/kWh). For direct-fired solid waste power generation projects, the FiT was set at 2,114 VND/kWh (10.05 US$ cent/kWh); for solid waste landfill and biogas-fired power generation projects the FiT is 1,532 VND/kWh (7.28 US$ cent/kWh), and the solar PV FiT is 2,086 VND/kWh (9.35 US$ cent/kWh).[74] In these cases, no claims can be made on support from the VEPF, and EVN's subsidiary companies must absorb costs into the total cost of the power mix.

As explained in sections I.1 and I.2, the MOIT participated in the formulation of Viet Nam's INDC (which went on to become the NDC).[75] Climate change mitigation (the mitigation of GHG emissions) is required in the energy sector as a result of Viet Nam's approval of the Paris Agreement, but the rate of emissions mitigation in the sector is modest. The Viet Nam NDC's GHG emissions mitigation targets are 8 per cent reduction against the BAU scenario by 2030 compared with 2010 if using its own means, and 25 per cent reduction by 2030 contingent on international support. However, the targeted rate of reduction from the energy sector is set at only 4.4 per cent and 9.8 per cent, respectively. More than half of total emissions reduction would be achieved in the Land Use, Land Use Change and Forestry (LULUCF) and agriculture sectors (Table 4).[76] These low percentages represent choices in energy policies, leading to a relatively low rate of emissions mitigation against BAU and a high absolute increase in emissions. As shown in Table 3, the Vietnamese energy-sector emissions in the BAU scenario

Table 3. GHG emissions in 2010 and projections for 2020 and 2030 (BAU)

Unit: $MtCO_2e$ per year	2010	2020	2030
Energy	141.1	389.2	675.4
Agriculture	88.3	100.8	109.3
Waste	15.4	26.6	48.0
LULUCF	-19.2	-42.5	-45.3
Total	**225.6***	**474.1**	**787.4**

*Note: * in MONRE (2014a) and SR Viet Nam (2015a) this is given as 246.8 because of inclusion of CO_2 emissions from industrial processes, 21.2 $MtCO_2e$*

Source: Table 3.9 in MONRE 2015; based on MONRE 2014a and MONRE 2014b

Table 4. GHG emissions reduction targets by 2030 compared to BAU

Sector	Unconditional		Conditional	
	Target (%)	GHGs ($MtCO_2e$)	Target (%)	GHGs ($MtCO_2e$)
Energy	4.4	29.46	9.8	65.93
Agriculture	5.8	6.36	41.8	45.78
Waste	8.6	4.16	42.1	20.23
LULUCF	50.05	22.67	145.7	66.0
Total	**8%**	**62.65**	**25%**	**197.94**

Source: Table 3.26 in MONRE 2015

are projected as 141.1, 389.2 and 675.4 metric tonnes of carbon dioxide equivalent (MtCO2e) per year for 2010, 2020 and 2030, respectively, based on policies that were in place in 2015.[77] This would be reduced by 29.5 MtCO2e per year by 2030 in the scenario where Viet Nam's mitigation is done with domestic resources, or by 65.9 MtCO2e per year in the same time frame with international support (Table 4).[78]

Viet Nam has also issued a Plan for Implementation of the Paris Agreement in which the main responsibilities for reducing emissions in the energy sector are allocated to the MOIT.[79] There is margin to revise the targets for this sector's emissions to make them significantly more ambitious, which would incidentally incur financial benefits to the country. The assumptions on renewable energy investment costs used in the calculation of the targets were conservative, and since the formulation of the I/NDC (in 2015) the costs of renewable energy have fallen further, in particular for solar PV.[80]

II. Social aspects of an energy transition

II.1 Access to energy

The rapid growth of electricity demand is threatening to increase the number of blackouts, affecting especially industries in rural zones in the south of Viet Nam, which can be very costly for businesses.[81] Access to uninterrupted power is one reason for promoting large-scale investment in coal-power plants in, for example, the Mekong Delta.[82] But the same argument could also be a force for expansion of renewable power production, as was demonstrated through the cancellation of a coal-fired power plant plan in Bac Lieu province on environmental grounds, shortly after the fish die-off near the shores of the central coast in 2016 (see section II.4), and the subsequent promotion of wind power expansion.[83]

Viet Nam has a much higher share of the population with access to electricity compared with other countries in the Association of Southeast Asian Nations (ASEAN) where on average 88 per cent accessed electricity in 2011.[84] The data on rural electrification of Viet Nam show increased access to electricity in remote areas with power grid connection of 99.85 per cent of communes and 98.88 per cent of households by 2015 (Figure 4).[85] In 2013 the prime minister approved a programme on electricity supply to rural, mountainous and island areas to bring electricity to 100 per cent of all communes and villages by 2020.[86] This programme targets an estimated 1.3 million households and it is currently being executed. This concerns mainly the extension of the national grid into remote communities. Some mini-grids with solar PV and other sources have been developed on islands. In some of the remotest communities, mini and micro hydro-electricity can be found (village and household scale).

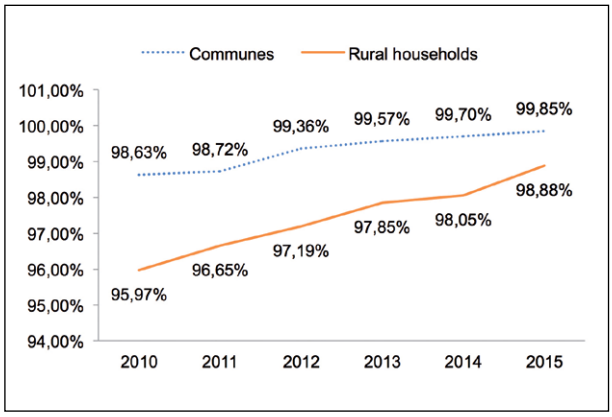

Figure 4. Rural electrification in Viet Nam 2010-2015. Source: EVN 2017.

For rural areas far from the grid, where some have no electricity access and others suffer frequent interruptions, further expansion is complex and costly. Non-hydro renewable energy solutions are rarely deployed. One study assessed the feasibility of off-grid renewable energy generation and the economic viability of stand-alone, household-sized solar PV systems of 130- and 100-watt (W) installed capacity for solar conditions in the north and the south, respectively, and a 150 W wind turbine. It was found that the levelized cost of solar PV was lower than the cost of energy from gasoline generators in all regions, and was cost-competitive with grid extension.[87] This was studied in 2005-2006, and since then wind power and solar PV system costs have fallen considerably, and the efficiencies have become much higher. As recently as 2015 the financial feasibility of grid-connected household level systems in urban areas under a proposed net metering regulation was still considered negative, because of the low prevailing retail tariffs against which the roof-top production would be offset.[88] However, in early 2017 household systems on the Vietnamese market were reaching costs as low as US$1,350 per kW installed capacity (without battery backup). With a net metering regulation, such systems would pay for themselves in 5-10 years, depending on circumstances, especially sunshine, which varies per region, against an economic lifetime of at least 20 years. And according to one of the interviewees, it is now possible to build a 1 MW solar plant for US$ 1 million in Viet Nam, which would make it competitive *vis-à-vis* coal and gas-fired power generation.

A high share of the population of Viet Nam still relies on traditional use of biomass for cooking (56 per cent), while the average in ASEAN countries was 47 per cent in 2011. In 2005, as much as 90 per cent of the biomass produced as by-product from agricultural activities was used for household energy needs such as cooking and heating.[89] Just 2 per cent of animal and farming residues

and bagasse from sugar mills was used for bio-fertilizers and about 7.5 per cent was not used (food processing residue was sent to landfill, straw and rice and coffee husk was burned). Since then, biogas digesters have spread to many communities and interest in fuel-efficient cooking stoves has also spread to some extent. The Ministry of Agriculture and Rural Development (MARD) has partnered with the SNV to develop a nation-wide biogas programme from 2003, which has improved access to cooking gas for 168,000 households by early 2017 (see Box 7).

Several studies have investigated the impacts of energy subsidy reforms as well as the viability of existing measures to mitigate the high energy expenditure of low-income households.[90] The research shows that the impacts of increased energy prices on the most vulnerable groups cannot be fully mitigated by improvements in the design and implementation of the cash transfer programme. Social protection programmes should be broad-based and not apply exclusively to energy costs. Targeting households in a situation of increased energy costs may be best done through a more progressive electricity block tariff scheme.

An assessment of the demand of six energy sources and how energy price increases would affect household energy consumption and fuel substitution shows that the costs of reducing subsidies on fossil-fuel energy is relatively small, and the government would gain revenue.[91] However, price increases could drive poor people to switch back to traditional fuels such as coal and firewood or cheap coal briquettes. These are readily available in many parts of Viet Nam and cheap but they are also inefficient, pose health hazards due to high levels of indoor pollution and cause environmental degradation.

II.2 Energy prices and affordability

Energy prices are comparatively low in Viet Nam, but consumers often do not perceive them this way. Energy price increases are a sensitive issue and widely reported by the media.

Petroleum products are subject to price controls and are uniform across the country; and import, environment and sales taxes on petroleum products are low.[92] According to a global information service reporting on 171 countries and territories, the price of petrol on 27 March 2017 was US$ 0.24 to 0.47/litre in some Middle East oil-producing countries, and was US$ 1.44 to 1.67/litre in some EU countries at the expensive end of the spectrum.[93] In Asia, the price was US$ 0.81 in Viet Nam, 0.89 in Cambodia, 0.99 in Thailand, 1.00 in China, and US$ 1.08/litre in Laos. The domestic prices of petroleum products are subject to international price fluctuations as Viet Nam's refinery capacity does not meet national demand. There is a price stabilization fund, based on a surcharge, that cushions the impact of major international price increases in petrol and diesel, though the effectiveness of this fund has been questioned.[94] Indirect subsidies on petroleum products were reported some years ago, but now appear very limited.[95] Nevertheless, calls for public-sector support for expansion of the refining capacity of Petrolimex show that government support continues to be expected at a significant scale.[96] Transport fuels can be accessed everywhere in Viet Nam, including the remotest communes. A system to subsidize kerosene for lighting in remote communes is still in place, benefiting some of the poorest people including many ethnic minorities who are not yet connected to the power grid.

Electricity pricing is also strictly regulated in Viet Nam, and prices are low when compared to other countries. This is said to be important for competitiveness of businesses and to support the relatively poor population. Comparisons with other countries are difficult because of challenges in the calculation of the average: In every country tariffs are different per type of customer, amount consumed, time of day or week, etc. There are different costs to the power sources in the power mix of each country, and there are strong differences in taxation, which explain why in some countries tariffs may be as much as three or four times as high as in others. Nevertheless, very few countries appear to have average tariffs as low as Viet Nam's, which was 7.6 US$ cents/kWh in 2015 (Figure 5). According to Worldatlas.com,[97] tariffs at the lower end in Sweden, Canada, Finland, Australia, South Africa and the United States were 8-10 US$ cents/kWh in 2014, and, at the higher end of the spectrum, tariffs in the United Kingdom, Germany and Italy were 15-21 US$ cents/kWh. Average tariffs were above 10 US$ cents/kWh in Thailand, 11 US$ cents/kWh in Malaysia, and above 20 US$ cents/kWh in the Philippines in 2012.[98]

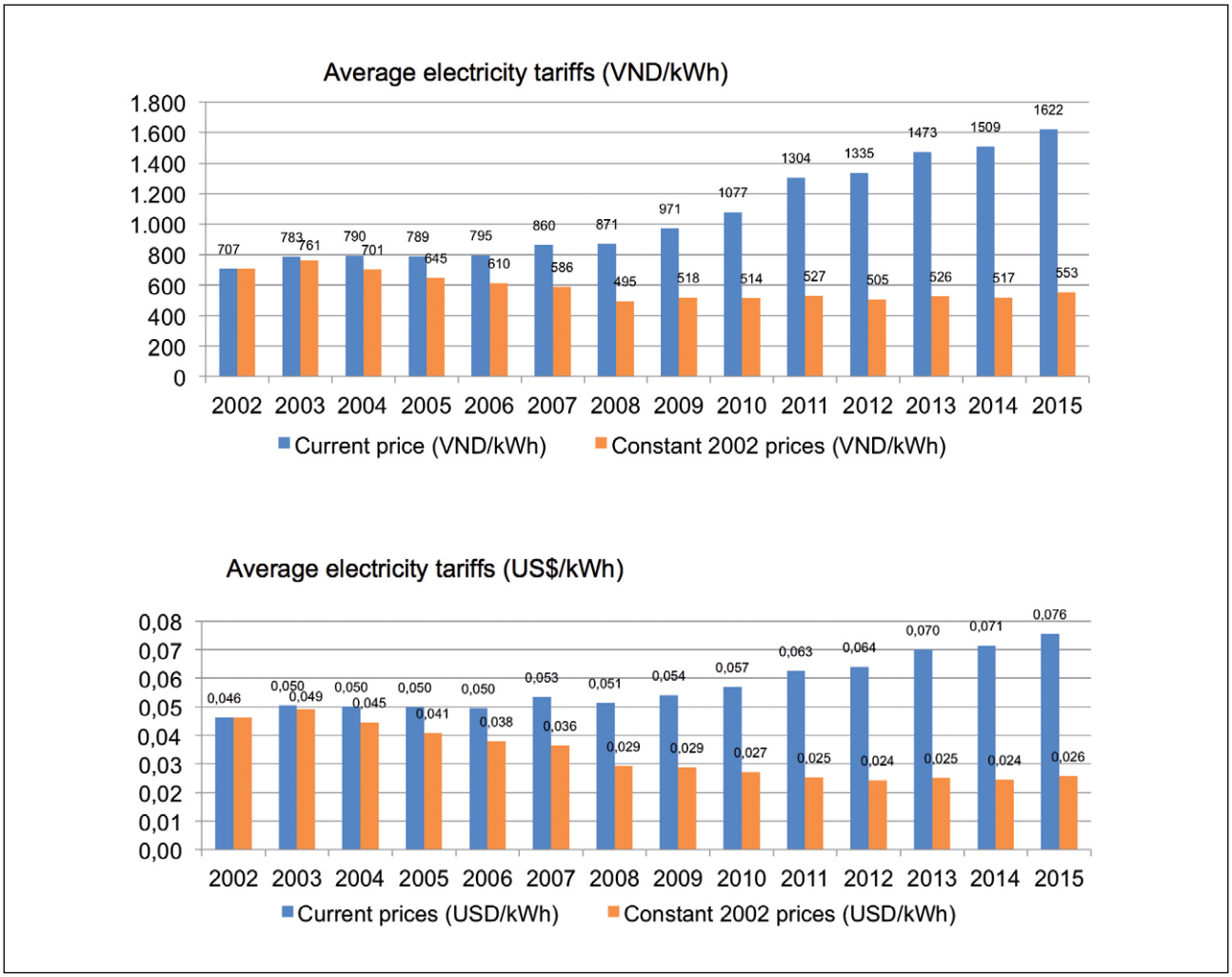

Figure 5. Average electricity retail tariffs in Viet Nam.
Source: Figure 10 in UNDP 2016.

Average electricity retail prices in VND in Figure 5 correspond to official pricing tables, with the latest increased price in 2015 still being the tariff in mid-2017. In 2016 and early 2017 the tariff expressed in US$ will have fallen somewhat because of devaluation in the VND, and in constant 2002 prices there has been a slight decrease since 2015, as official inflation was 4.74 per cent in 2016.

Indirect fossil fuel subsidies persist because of coal and gas use in electricity production,[99] despite a policy commitment to phase out fossil fuel subsidies. Domestic coal used for power production is usually kept below international market prices except for periods with very low global market prices, which in effect equates to a subsidy.[100] Moreover, coal transport infrastructure is in part publicly financed. In addition, the control of retail prices reduces state revenue to state-owned EVN subsidiaries: Foregone state revenue and the bailing out of debts are also subsidies that are ultimately borne by the taxpayer. Furthermore, cross-subsidies occur because hydro-electricity is still dominant in Viet Nam's power mix, which is cheap and enables the comparatively low average retail tariff.

EVN losses and debt are occasionally reported in the media,[101] including losses of more than VND 10,000 billion reported in 2010 (US$ 500 million at the time) because of investment in non-core sectors such as telecommunications, banking, insurance, and real estate[102]. According to EVN's

consolidated financial statement for 2015, it had US$ 28.2 billion in total assets on its balance sheet, including owner's equity of US$ 8.2 billion, non-current liabilities in the amount of US$ 14.7 billion and current liabilities of US$ 5.3 billion.[103] Total revenue from electricity sales and other activities was US$ 10.6 billion in 2015, and EVN reported a pre-tax profit of US$ 200 million that year. It was later disclosed that US$ 374 million in losses due to exchange rates had not been accounted for, according to an auditing firm, so in fact EVN made an overall pre-tax loss in 2015. EVN has asked the Government to be allowed to book those losses spread over five years to avoid having to increase power tariffs.[104]

Some observers argue that with the high (and growing) level of liabilities, the average retail tariff must go up soon. Higher tariffs would also result from complete phase-out of the indirect fossil fuel subsidies for electricity production. However, at the beginning of 2017 the MOIT communicated that a tariff increase was not imminent and would be decided later. Indeed, although the EVN debt burden must be serviced (i.e. interest must be paid to financiers), it is not much more leveraged than large electricity providers in other countries. Furthermore, an unknown but likely significant part of the liabilities were financed through ODA on favourable terms, and these loans are generally underwritten by the government. Nevertheless, Viet Nam's own projections of future power demand would require an increase in investment estimated at US$7.5 billion per year to 2020 by the World Bank. This is more than double the annual investment in recent years and public sources are not available for this kind of increase. The World Bank argues that this level of investment can only be achieved through "financial recovery of EVN", efficiency improvements, implementation of investment and debt financing strategies, improving risk management, and cost-based tariffs, with tariff increases estimated at 40 per cent spread over four years, after which increases would follow the rate of inflation.[105]

Viet Nam's power tariffs are low and homogeneous: tariffs in remote areas are the same as elsewhere, despite larger investments in infrastructure per electricity customer. In the context of an energy transition, research has fed into debates about increasing power tariffs and potentially negative consequences for low-income households and certain businesses. It is assumed that power tariffs will increase because of the following:

(1) Given EVN's financial situation in the context of low tariffs an increase is inevitable, while other energy SoEs also face financial challenges.
(2) A phase-out of indirect fossil fuel subsidies would shift the financial burden from taxpayers to power consumers.
(3) A phase-in of a carbon tax or fee would make the overall energy bill more expensive for the period in which fossil fuels continue to be the dominant source. This revenue could be used by the government to mitigate the longer-term impact on consumers, for example to support the development of renewable energy sources, and perhaps cap the price increase for low-income consumers.

The United Nations Development Programme (UNDP), working with national and international research partners, has estimated that fossil fuel costs are realistically likely to increase by about 15 per cent due to subsidy removal and taxation, and it modelled the economic consequences of such an increase in three steps over a period of three years. It concluded that:

(a) If funds saved from subsidy removal and generated by a carbon tax are invested in productive, low-carbon activities then GDP growth will increase because of efficiency gains.
(b) Low-income households will feel negative effects on consumption levels, but these could be compensated from additional revenue.
(c) There will be pressure on some energy intensive businesses, but others would benefit from energy efficiency gains.
(d) There will be a significant reduction in GHG emissions, as compared with BAU.[106]

The World Wildlife Fund (WWF) commissioned an assessment of two scenarios for a transition to renewable energy, one with a large share of renewable power (Sustainable Energy Scenario, or SES), and a scenario with 100 per cent renewable power (Advanced Sustainable Energy Scenario, or ASES) by 2050. The assessment compared the conditions and inputs for each scenario, as compared with the BAU scenario, which relies heavily on coal and gas-based power. Both alternative scenarios include energy efficiency measures,

solar, wind and biomass-based power, but in different proportions. It concluded that:[107]

- In the two transition scenarios, most electricity would be generated from domestic resources, whereas the BAU would require large scale gas and coal import.
- The LCOEs of the national power mix in the transition scenarios rise slightly in the first three-to-five years, but after that they are consistently lower than in the BAU until 2050. All scenarios converge to about 90 US$/MWh by 2050;
- The LCOEs for the SES and ASES are insensitive to a carbon price, unlike the BAU scenario.
- Capital investment under the BAU is lower but the need to supply fuel raises the net present value of the total costs.
- An increase in sustainable energy generation capacity would create jobs (see section II.3).

These modelizations are strongly supported by the latest trend in renewable energy costs, making the picture for SES and ASES even more optimistic.[108]

In the present environment of comparatively low energy costs, the Vietnamese economy and many businesses are energy inefficient by international comparison. Consequently, the potential for economically beneficial energy efficiency gains is substantial.[109] Several assessments have been made of the negative impacts on business of temporary increases in the costs of energy, in particular of electricity, and ways of mitigating those given the present comparatively low energy prices.[110] It was concluded that some of the most vulnerable businesses are domestic small and medium enterprises (SMEs) with high levels of energy consumption. But these businesses can be very responsive to energy price increases, and many would cope well if the cost increases would be gradual, predictable, and limited, as the above-mentioned research initiated by UNDP and WWF has suggested it would be. Many businesses feel they could save energy through minor changes in management, production or distribution processes. A follow-up assessment confirmed these findings, and also found that businesses believe that basic energy audits can deliver quick benefits.[111] The assessment also found the first concern of businesses is power supply stability rather than price. Back-up generators may be available at a cost to large businesses but most SMEs must suspend production during blackouts. This study also analysed the VNEEP and business support programs and projects on energy efficiency, which focus on awareness raising and technical support. SMEs report that they do not always benefit from the little support available. Large businesses are better at accessing and absorbing advice, and can better afford commercial energy-efficiency services and investments. It was also found that commercial banks have limited interest in lending for energy efficiency. Similar sentiments were expressed in a survey of foreign-invested businesses in Viet Nam:[112] Only a small proportion of foreign businesses are high energy consumers; only 8 per cent of surveyed businesses felt that energy costs were "very significant" in their investment decision; a 10-per cent increase in energy costs was already considered likely in the near future by the majority; and two-thirds were willing to pay up to 20 per cent more for renewable energy. The latter finding is consistent with recommendations from EuroCham's survey of solar PV experts:[113] A premium FiT for solar PV is needed because current proposals would lead to low profitability of investments in, for example, rooftop or large solar PV power plants; other barriers to investment in solar PV include regulatory impediments, power buyer credit risks (i.e. will EVN power distributors off-take and pay the bill?), and corruption risks.

A model study of the effects on poverty of a 5-per cent electricity and 10-per cent fuel price increase showed a long-term increase in poverty incidence by 0.7 per cent, in the absence of remedial action.[114] Compensation for households living below the poverty line should be larger for urban households than for rural ones, especially urban households in mountainous areas. This finding is consistent with other research on the topic. This research focused on the electricity pricing structure and cash transfers, and suggested the following:[115]

- Inflation resulting from energy price increases may be substantial, partly because of indirect effects on the prices of other goods and services consumed by households. A combined increase of 20 per cent in electricity and petroleum prices would increase inflation rates to 4 per cent. But inflationary impacts can be mitigated and the overall inflationary threat has reduced considerably compared to the period 2011-2012.
- To protect low-income households against high electricity costs, Viet Nam formerly had a lifeline tariff and a cash transfer scheme. People in off-grid areas

received cash for fuel, and low-income groups in on-grid areas were charged at the very low lifeline tariff rate for a maximum 50 kWh/month, and received a monthly cash transfer of 30,000 VND (1.5 US$).

- In 2014 the lifeline tariff was eliminated, the targeted cash transfers were increased to a sum equivalent to 30 kWh/month, and the Incremental Block Tariff (IBT) scheme, which applies to all household consumers, was made considerably less progressive[116]. This new system does not target poor and low-income households very well. It is costly, administratively inefficient, does not deliver timely benefits, and the benefits for poorer households are low.
- In early 2017, analysts proposed a reform in the context of an expected increase in the average electricity retail tariff. For people connected to the power grid, the IBT structure would be made more progressive, with the first 30 kWh/month set at a minimal price (nearly nil) for all electricity users, and cash transfers would be eliminated or integrated into other social assistance programs. The cost of this would be covered through higher charges on the other blocks in the IBT, affecting high-intensity consumers. People who are not connected to the power grid would receive social assistance to consume alternative energy equivalent to 30 kWh/month electricity. Increasing prices for higher levels of consumption would incentivize better-off people to improve efficiencies and install rooftop solar PV systems and water heaters. These suggestions have been debated by experts, published in the media, and heard by decision makers, but so far without consequence.

II.3 Energy and jobs

Publicly available data on current employment in the energy sector are scarce and not well differentiated. Coal mining employs about 140,000 workers directly and the power sector employed roughly 120,000 in 2015.[117] The number of direct jobs in coal mining will not increase significantly because coal for future power plants will mainly be imported. A model study estimated that BAU under the PDP7 (the seventh Power Development Plan before it was revised in 2016) would create 6.6 million job-years from 2015 to 2050. It gives two alternative scenarios, with the SES generating 8.6 million job-years, and the ASES 11.6 million job-years.[118] The alternative scenarios assume energy efficiency measures and a strong development of solar, biomass and wind energy.

Net employment gains from a larger share of renewables in the energy mix are reported internationally too. And whilst women remain a minority of workers, the share of women in renewable energy-related jobs is larger than that in conventional energy production.[119] Jobs in renewable energy are usually "clean and green" and at higher skill levels compared to the mining and transport of coal. Retraining coal miners in some form of transition for employment in the renewable energy industry might be needed, and alternative employment might be created in mining areas.[120]

Household-scale bio-digesters have been applied at a fairly significant scale across Viet Nam. These programmes have succeeded in generating some local jobs, in particular for construction teams. Another benefit is time saved in cooking, leading to an increase in production as women can spend more time on remunerated tasks (section II.1; Box 7).[121] Other small-scale, local initiatives also report the creation of local jobs for sustainable energy production (see Box 8). One of these is the VACB model, which adds biogas facilities to the existing VAC system of integrated vegetable, fish and livestock cultivation (the acronym comes from the Vietnamese *vuon* or "garden", *ao* or "pond", and *chuong* or "livestock pen"). The model is seen as sustainable agricultural production associated with job creation in rural areas.[122]

Foreign direct invested companies and some Vietnamese companies are already producing renewable energy equipment for export, employing and sometimes training relatively highly qualified staff for their modern production facilities (see Box 2).

II.4 Popular perceptions of energy

The views on fossil fuel pollution and renewable energy of different stakeholders, including the general public, are briefly presented in section I.2, and the sentiment of businesses and low-income groups on energy price increases were discussed in section II.2. Such perceptions are discussed further in this section.

Transition to low-carbon or renewable energy as a concept or term is not being used widely, but objections against the environmental effects of the expansion of coal-fired power generation and use of fossil fuels in industry do feature in the media including editorials or opinion columns, as well as blogs and social media. Similarly, there are frequent media reports about the advantages and sometimes the disadvantages of renewable energy. Workshops for officials, development professionals and researchers often invite journalists who use the workshop inputs, presentations or press releases in their reports. The media also report on the advantages of fossil fuels, including the response of coal and gas-fired power generation to the growing energy demand, for example planned and realized expansion of coal-power capacity.

The government-endorsed VEA has many of members with close links to the country's decision makers. In early 2017 it published a series arguing why Viet Nam must expand its coal-fired power supply.[123] The arguments include that:

(i) coal power is non-polluting thanks to technological advances;
(ii) negative information on coal power in the media is not reliable;
(iii) the share of coal power in total power production in many countries is still very high, so Viet Nam can also continue to use coal, even more so given its current low GHG emissions levels;
(iv) renewable energy would be much more expensive than coal power;
(v) coal power is more stable than renewable energy, because the latter depends on the weather;
(vi) renewable energy is small scale;
(vii) the potential of renewable energy is not reliable because it was mainly assessed by foreigners; and
(viii) Viet Nam has more experience with coal power than with renewable energy such as solar and wind power.

On the other hand, the NGO GreenID, which co-leads the VSEA, organized a consultation in 2016 of alliance members on the myths concerning renewable energy development, resulting in publications that were shared widely. This included analysis of the widespread scepticism regarding solar and wind energy, especially among energy professionals such as those in the VEA and decision makers. The VSEA challenged the myths surrounding renewable energy as follows:[124]

(a) Solar and wind energy is intermittent and cannot supply power around the clock, but internationally many strategies have been used to deal with this intermittency. Solar PV and wind power have become part of the baseload in some countries, reaching a very high share in their power mix.
(b) Fossil fuel use could create jobs, but international experience is that renewable energy generates much more employment overall.
(c) Coal would be an option to meet Viet Nam's surging energy demand, but research has demonstrated the significant potential of solar, wind and also biomass energy in Viet Nam. Furthermore, relying on coal would vastly increase coal imports and expose Viet Nam to coal price volatility and risks of disruption in the coal supply, as well as causing global climate change and local pollution and health costs.
(d) Renewable energy has historically been expensive, and was perhaps initially more affordable to developed countries, but renewable energy costs have plunged and are even more competitive when taking into consideration their environmental and health benefits. Cost prices (LCOE) of solar PV and wind in many countries are already at parity with or below those of coal and gas power.
(e) Renewable energy does not in fact create dependence on foreign technologies; in fact domestic companies and foreign-owned companies in Viet Nam already manufacture components for export, despite highly competitive global markets and a minuscule local market (Box 2).

Renewable energy, including small and medium hydro-power and biofuels, is presented positively in almost all media reports because of its green and clean image. There are frequent reports on energy efficiency achievements by businesses or public organizations. There are also numerous reports of announcements of renewable energy investments, even though few are materializing (see also Box 1 and Box 3). Images in the media of what represents "green" and "clean" often include solar PV panels or wind turbines. Images drawn by youngsters of a climate-resilient, green and clean future as part of research on climate change may also include those images, in addition to trees.[125] They get these images from books, the public media or the internet, not from

their own observations because solar PV panels or wind turbines are very rare in Viet Nam and virtually invisible to the general public.

Renewable energy is also contrasted with the pollution associated with the growing use of fossil fuels and related threats. A national survey of 3,500 randomly sampled interviewees complemented by 16 focus groups concluded that Vietnamese people are "very aware" of the effects of climate change on their own rural livelihoods. Urban people are in particular concerned about health and access to clean water. Urban youth feel they lack specific and practical information on how to respond to climate change. Many want to participate in groups and in their communities, and believe that collective action can be effective given the proper guidance. People in other age groups in urban areas expressed a willingness to learn from their children.[126] Reports about the problems of solid waste from coal-fired power plants have been carried by the public media, such as in the case of the Vinh Tan coal-fired power plant, which resulted in local protests in 2015.[127] In addition, air quality is deteriorating to the extent that many people feel it and reports of respiratory diseases have increased over the past few years, especially in and near the major cities; this is reported regularly in the public media and discussed on social media. Air quality in Hanoi can now be monitored in real time by every citizen through international networks that access monitoring stations that are reporting on an air quality index (AQI), including the worst air pollutants in fine particulate matter, PM2.5[128]. This demonstrates that the Hanoi air quality ranges between "moderate" to "unhealthy" for much of the year.[129] There are also stations monitoring air quality per the official Vietnamese AQI that can be accessed online, but this (national, official) AQI excludes PM2.5 and tends to report that Hanoi air quality is "good" or "medium" and more rarely "bad", rather than grade the pollution levels on a health scale.[130]

Several cases of severe water pollution, some related to power production, have led to protests and were widely reported in the public media and discussed in the social media (see Box 4 and Box 5).

Section II.2 refers to surveys of the perception of energy costs in Viet Nam by domestic and foreign-invested businesses. It concludes that this is not decisive for investments, and that modest energy price increases can be absorbed by efficiency improvements and other measures.[131] The perceptions of households were also assessed, with a focus on low-income households, through qualitative surveys including in-depth focus groups and household interviews, the first of which happened towards the end of an episode of high inflation. The following were some of the findings from these surveys:[132]

- The major energy companies are perceived as inefficient and there is low confidence in electricity price reform, but respondents accept the need for energy price increases.
- People prefer gradual price increases accompanied by policies to mitigate negative impacts.
- There is a lack of information and communication on energy costs and policies.
- Informal household businesses, migrants, and the poorest may be affected more than others by power tariff increases because there are sometimes intermediaries and a high informal price of electricity, which in the past has increased faster than the official price.
- Respondents are worried about the spill-over impacts on other prices, which has led to increased production costs and decreased demand for their products. For example, farmers experienced a decrease in the price of rice and increased input costs because of energy price increases, especially irrigation water pumping.
- Migrants are concerned about decreasing savings and risks of temporary layoffs.
- Offshore fishermen are sensitive to diesel price increases, as diesel makes up 30-60 per cent of the costs of a fishing trip.
- Common measures of household businesses to cope with electricity tariff increases include accepting lower profits and saving on costs such as transport. The poorest farmers reduce the irrigation of rice crops and increase the proportion of work they do manually, while the better-off invest in new, more energy-efficient equipment.
- The impacts of energy price increases on low-income groups, for example higher costs of inputs and transport, can be best mitigated through a tariff scheme. The present system of a block tariff and cash payments to the officially poor and other social assistance group is administratively inefficient. It could be replaced by a block tariff scheme with a

Box 4. Tree felling in Hanoi sparks an impromptu environmental movement

In 2015, the Hanoi authorities started felling and replacing trees at a significant scale, targeting 6,700 mature trees, including many very large and healthy specimens. This initially caused comments in the official media, followed by increasing exchanges on social media questioning what was going on. An open letter to the Chairman of the People's Committee of Hanoi on Facebook was also published in some official media and triggered further comment.

Initial reactions by officials to critical comments from the public were dismissive of the need for consultation, which made matters worse because the issue had already touched people. Old and large trees are part of the beauty of Hanoi, they provide shade in hot summers, and are part of people's lives, even their identity. People, especially younger individuals, started to tie coloured ribbons around trees and put up signs such as "I'm fit, so don't kill me". Architects, artists, and academics spoke out, including forest specialists explaining that plans for replanting included inappropriate tree species. Lawyers raised the issue, and NGOs mobilized their networks and organized seminars. Social media were extremely lively, petitions were handed to the authorities, and street marches were organized. The official media followed the social media with investigative journalism, following up on suspicions of misconduct in implementation of the programme.

Finally, the tree replacement programme was suspended and an official enquiry announced regarding the decision-making on the programme and its implementation. But protests were also met with an increasingly tough approach by the authorities. Security officers pressurised managers of certain Facebook pages and searched for what they called "hostile forces" behind these managers. But it was miscommunication and misconduct by Hanoi officials that created public anger and frustration instead of some hidden force.

(Source: Le Quang Binh et al. 2015.

Box 5. Fish kill in central Viet Nam

The case of sea water pollution by Taiwan's Formosa Ha Tinh Steel Corporation (FHS) in central Viet Nam in 2016 attracted widespread protests, locally as well as in Hanoi and other parts of Viet Nam.

Mismanagement caused massive fish death and loss of livelihoods in the fisheries and tourism industries. The Formosa facility includes the largest steel plant of Viet Nam, a co-generation coal-fired power plant, and a sea harbour for coal and steel transport.

Facebook was very important for the communication and convening of protestors, as well as reporting, including videos of protests filmed with drones.

The US$ 500 million fine imposed on Formosa for losses to the small-scale fishing industry and tourism is popularly seen as insufficient, according to sentiment expressed in social media.

(Sources: Reuters 2016a; Reuters 2016b; http://www.fhs.com.vn/Portal/.

near-zero tariff for the first 30 kWh/month (for all households) and higher tariffs at higher consumption levels (see also section II.2). But informality would remain a constraint for migrants and others outside formal employment; and groups such as fishermen and farmers would need targeted support measures.

III. Political feasibility of an energy transition

III.1 Barriers to energy transition

Energy transition in Viet Nam includes the development of renewable energy, improvements in energy efficiency and energy saving, and a reduction of fossil fuel consumption through, for example, the electrification of transportation and the phasing out of coal-fired power plants. Different papers have identified the main barriers to energy transition in Viet Nam as well as the main stakeholders. These provide recommendations for addressing the barriers.[133] The barriers and the opportunities for a socially just energy transition lie in particular in the production and use of renewable power at different scales. The following gives an overview of the barriers and some of the recommendations to create opportunities, summarized in Table 5. The barriers discussed fall into the following categories: institutional and policy; economic and financial; technical and physical; and perception/awareness.

Institutional and policy barriers

There are several institutional challenges and shortcomings in policies and regulations:

Insufficient and ineffective policies and regulations on renewable energies: Many policies supportive of energy transition have been issued in Viet Nam, as mentioned in section I.5. They are expected to stimulate development of renewable energy as well as energy efficiency. However, interviewees argued that a lack of policies and poor policy implementation is holding development back. The lack of a renewable energy law creates legal uncertainties for investors,[134] and more concrete and detailed technical and administrative regulations are needed. For example, the 2015 REDS announced a net metering mechanism to promote prosumers, that is, individuals producing energy for their own consumption,[135] and recent solar PV policy states that solar energy rooftop projects can apply a net metering mechanism, where surplus electricity could be put back into the grid, and deducted from the billable amount of consumed power.[136] However, net metering regulations are yet to be issued and technical aspects must also be regulated, such as for the connection of rooftop systems to the public grid. Without these regulations, the potential investment will not be realized even though it is already financially attractive for some private businesses and households given the current retail tariffs and relatively low market price of solar PV equipment, in particular in the centre and south of Viet Nam.[137] Such regulations must be clear and detailed and administratively simple in order to reduce the risks for rooftop solar PV investors, and include clear responsibilities of EVN subsidiary companies.

Viet Nam needs a holistic approach and long-term vision for the development of its renewable energy industry. Its current manufacturing activities in the sector are still small and cannot supply equipment for large-scale renewable energy plants, so imports are likely to be needed. Draft industrial policies looking ahead to 2030 see the renewable energy industry as a priority. The REDS and other policies provide for tax exemptions for certain imported components and it has been suggested that tariffs on solar PV system components should be removed.[138] But there is no comprehensive tax regulation yet. There is also no clarity on incentives for domestic equipment manufacture, but Vietnamese companies are confident they can grow fast in the sector, especially with some measure of government support.[139]

Complex investment procedures for renewable energy: Potential investors in renewable energy must follow cumbersome procedures to get their investment licence. An investor must work with the relevant Provincial People's Committee to get their investment project approved in principle as a first step. The province's Department of Industry and Trade may then need to adjust the power master plan of the province, which in turn must be agreed by the central MOIT. The MOIT's approval is in any event required for an investor to work with the provincial Department of Planning and Investment to get a full investment licence.[140] Some provinces have master plans with renewable energy projects already included, such as wind power in Binh Thuan and Soc Trang provinces, a biomass master plan for Quang Ngai, and a solar PV master plan for Da Nang. Renewable energy is mentioned in the annex of PDP7-revised,[141] but there is no national master plan on renewable energy investments yet.

Table 5. Summary of barriers to energy transition in Viet Nam with some recommendations

Barriers	Key stakeholders	Some recommendations
1. Institutions, policies and regulations: – Insufficient and ineffective policies and overly detailed, impractical regulations on renewable energies – Complex investment procedures for renewable energy – Difficulty in connecting to the national grid – Strong and weak institutions and conflicts of interest	National Assembly, Communist Party, prime minister, ministers: Monitoring the development of energy sector, SoEs reform MPI: Business environment MOIT (ERAV): Power market reform, healthy competitive environment MONRE: Environmental performance	– Develop a Law on Renewable Energy, and Master Plans on renewable energy development – Establish a clear and simple process of PPA – Issue technical and administrative regulations – Speed up power market reform and link to renewable power deployment – Strengthen ERAV to ensure a competitive power market – Speed up SoE reform, separating energy SoEs from the MOIT – Increase transparency of SoEs, including EVN subsidiaries
1. Economic & financial: – Low power price (lack of pressure on energy efficiency investment) – Low FiT for renewable energies – Investment capital constraints	MOIT, MOF, MPI, SBV	– Phase out all support for fossil fuel-based power generation and introduce a carbon fee or tax – Consider higher FiTs in Viet Nam, and the auctioning of rights to build renewable energy plants – Issue regulation on net metering and direct PPAs – Improve legal strength of standardized PPAs
3. Human & physical capacities: – Poor human capacity of Viet Nam on renewable energy – Poor infrastructure	MOIT, EVN, Development Partners	– Build technical, financial, administrative capacity at several levels – Stimulate investment in: transmission and distribution infrastructure; smart grid equipment; and pumped storage hydro-power[146]
4. Perception – Negative perceptions of renewable energy – Lack of appreciation of the advantages of renewable energy and the risks of fossil fuels – The challenge to change perceptions	Communist Party, prime minister, ministers, National Assembly, provincial authorities, associations, media	– Short, clear and correct media messages based on sound evidence – Campaigns on the benefits of solar and wind power, and information on the negative sides of coal power development and other fossil fuel use

Source: Authors' compilation based on literature and expert interviews

Difficulty in connecting to the national grid: Grid connection is key for the success of most renewable energy projects. Renewable energy policies assume a grid connection, but in practice this remains a barrier. It requires investors to finalize a PPA with an EVN Power Corporation (which distributes and delivers to customers; see Figure 3). After issuing the support policy on biomass power it took the MOIT one-and-a-half years to issue the standardized PPA.[142] Furthermore, regulations are not clear and investors must negotiate with an

EVN Power Corporation, who may see its benefits or those of other EVN subsidiaries negatively affected by adding renewable energy capacity. Notably, there is no obligation for EVN subsidiaries to reach an agreement, so negotiations may take time, which is costly for an IPP.[143] Interviewees argued that because EVN subsidiaries are the single buyer, this situation cannot be resolved. They suggested that direct PPAs can to some extent address the problem, whereby small and larger power producers, including new and private companies, as well as those with rooftop solar PV systems, sell directly to large customers in industrial zones. This is being piloted at the high-tech industrial park in HCMC.[144] There is a widespread perception that renewable energy FiTs are too low in Viet Nam, but this is not the only challenge in making PPAs bankable. Importantly, the existing standardized PPAs lack the necessary legal form and strength to allow IPPs to access credit. Investors need clear, legally enforceable PPAs to reduce risks and costs of equity, e.g. standardized PPAs providing a long validity period to power generation licences, clarity on the process for termination of the PPA, provisions to reduce off-take risks, and provisions on decommissioning at the end of the investment lifetime.[145]

Strong and weak institutions and conflicts of interest: As mentioned in the section I.4, EVN is dominant in power generation and still has a monopoly in power distribution and sale. Energy transition will cost the organization market control and influence. This also applies to VINACOMIN if they or EVN subsidiaries have to withdraw plans for coal-fired power plants drawn up in PDP7-revised. The status quo would be upset in the case of a radical transition because companies and managers who benefit from the domination of coal stand to lose from a large-scale deployment of renewable energy. In the words of one interviewee, *"coal has an enormous advantage for some in the system because it needs to be delivered for the lifetime of the power plant. Those in the trade and transport of coal are winners, they get a cut. With renewable energy, you do not have any fuel purchase and transport – the winning is only with the commissioning / development process including equipment purchase and construction. After that the operator needs to sell power and get paid, which is risky even if the FiT would be a good, profitable FiT.* [There are] c*ases where they simply do not off-take even if they are supposed to take everything that is being produced, or they do not pay".* EVN subsidiaries may also fear a financial loss from having to buy renewable power with higher prices than other sources without adjustment of the retail tariff. A further source of resistance to large-scale deployment of renewable energy may be that some EVN subsidiaries fear an additional work burden relating to grid connection, or additional investment in the main transmission and distribution networks to absorb many, small distributed renewable power sources. As power market reform progresses, the regulatory power of ERAV will need to be very strong, given the anticipated intensification in competition in wholesale and later retail markets, along with a push for greater deployment of renewable electricity. Its strengths will need to include effective enforcement of any future regulations governing renewable portfolio standards. The MOIT has the leading role in power-sector reform, regulation and supervision, and it is also the state-representative owner of EVN and other energy SoEs (see section I.5), so it has multiple interests that may conflict at different levels. In current SoE reform plans, the role of the MOIT as owner may be taken away, which would reduce the potential for conflicts of interest. But to fully avoid these, more market players should be mobilized, and the independence and strengthening of ERAV is important.

Economic and financial barriers

There are also several economic and financial barriers to a socially just energy transition, and opportunities to achieve it:

Low electricity price: As discussed in section II.2, electricity in Viet Nam is comparatively cheap (see also Figure 5), and due to a differentiated tariff system, it is cheaper for the industrial sector than the service sector, as well as cheaper for low-consuming households than for high-consuming households. The last tariff increase was in early 2015 and it is uncertain that there will be an increase in 2017, even though consumer price inflation in the intervening two years has been about 5 per cent in total. Low tariffs discourage investment in the power sector and limit the benefits of energy efficiency investment, as well as the shift toward less energy-intensive industries. Raising electricity retail tariffs, which will likely happen under either BAU with imported fossil fuels, or scenarios involving high FiTs and large-scale renewable energy deployment, is politically sensitive as

it is not supported by public opinion.[147] Price increases resulting from the BAU or phasing out of indirect subsidies on coal, diesel and gas power, and from the introduction of a carbon tax or a fee (as announced in the REDS), must be well managed in order to limit the effects on inflation and business costs as well as low-income household consumption. This mitigation of the effects of price increases appears possible.[148]

Low FiT: The FiT for wind power is set at 7.8 US$ cent/kWh, which is too low for commercial investment in wind power projects (see section I.2, I.5, and II.2; Box 1), although international investment costs in wind are reducing. Among the currently operated wind-power projects, one has a higher FiT because it is an offshore project. The other wind projects operate with the lower FiT, and they have accessed cheap capital and benefited from other preferential conditions. The government has been considering increasing this rate for more than two years, but without action. The recently issued FiT for solar PV is set at 9.35 US$ cent/kWh. This is not very attractive to investors but could be enough to make a small profit according to some entrepreneurs if other conditions are good, such as a legally enforceable, standardized PPAs. The solar PV and wind costs will remain relatively high in Viet Nam at the start of large-scale deployment as capacities and the regulatory environment are still limited. But costs can be reduced depending on the production scale. One way of doing this could be through auctioning of rights to build certain power plants.[149] The renewable-power FiTs are low in part because of the financial limitations of the government subsidies of renewable energy (see section I.5). The solar PV and wind FiTs are higher than the average retail tariff in Viet Nam, which in 2015 rose to 7.6 US$ cent/kWh (see Figure 5). This made renewable energy unattractive to EVN distribution companies, who would make a loss on wind and solar PV components of the energy mix. However, the tariffs for certain customers at certain times can exceed 12 US$ cent/kWh,[150] so production can offset consumption in net metering schemes or through direct PPAs. This can make distributed generation, such as rooftop solar PV and other small renewable power systems, attractive with current tariffs under certain conditions.

Investment capital constraints: Investing in renewable energy requires a significant amount of capital but no fuel expenditure, in contrast to fossil fuel-based power. But Viet Nam's public investment capital is very tight, and the domestic banking system has limited capacity for large upfront investment in renewable energy projects. Some efforts by the State Bank of Viet Nam on green investment are improving the situation but progress is very slow. Foreign investors are interested in the Viet Nam markets but face high risks in terms of actual payments for electricity, which relates to legal weaknesses in standardized PPAs. In addition, EVN has low creditworthiness in the international capital markets so it is difficult for EVN to mobilize capital from private international sources. The organization depends heavily on the World Bank and other international financial institutions, as well as on loan guarantees from the government.

Human and physical capacity barriers

The following are the main human and physical capacity barriers:

Poor human capacity of Viet Nam on renewable energy: Human capacity for system management, construction, and O&M of renewable power sources needs to be improved, in central and local government, EVN subsidiaries, the private energy-service industry, and in local workshops. Viet Nam has done limited research, development and training on renewable energy, although different technologies are being covered in the curricula of universities and colleges. As one study on capacity-building needs for wind power put it: "*Local expertise exists for wind measurements and yield assessments, but full-scale technical designs, feasibility studies, environmental and social impact analyses, etc. as well as political advisory services through consulting for example are aspects of the value chain that have to be further expanded upon*"[151]. Capacities have been built across the country for the manufacturing, construction and installation of small-scale bio-gas production and use as well as solar water heaters.[152] Viet Nam has some companies producing solar PV equipment, though components are also imported (especially those for FDI manufacturing and assembly plants), and the domestically owned firms are still small. The same applies to wind power, as turbines are not yet being produced or assembled in Viet Nam (see Box 2). In sum, the capacities to develop non-hydro renewable power is low among domestic firms, including EVN subsidiaries, and government departments and regulatory agencies.

Building of technical, financial, and administrative capacity is therefore needed at different levels.

Poor infrastructure: Viet Nam lacks smart grid equipment and the capacity to manage supply and demand, and the electricity distribution network has limited reliability in some parts of the country. These are all used as arguments against deploying non-hydro renewable power, in light of the intermittency of solar and wind production. Viet Nam's power grid is capable of absorbing small amounts of non-hydro renewable power without much change to the power system. Nevertheless, to realize large-scale deployment would require: investment in transmission and distribution infrastructure; smart grid equipment to manage demand and supply better; and there must be additional storage capacity such as pumped storage hydro-power, for which there are already plans.

Perception barriers

Wrong perceptions are a major obstacle to an energy transition:

Negative perceptions of renewable energy: A major hurdle to renewable energy production are the negative images it has been given. Common beliefs or myths have been challenged, as discussed in section II.4.[153]

Lack of appreciation of the advantages of renewable energy and the risks of fossil fuel energy: Many benefits of renewable power have not been thoroughly discussed, and may be dismissed as being of minor importance. Benefits are environmental and economic, and, when compared to the BAU scenario (with a large share of fossil fuel energy), the health advantages are very significant. Some advantages may be recognized but may not be persuasive because of the perception that the risks of coal power development and fossil fuel use in manufacturing and transport are minor, and developing countries should accept this because they cannot afford renewable alternatives. But negative effects of the use of fossil fuels have been demonstrated, on the national economy, health and the environment. Air pollution could potentially result in tens of thousands of additional premature deaths per year if all present coal power plans are implemented in Viet Nam. There will be landscape damage from mining, dust pollution from coal transport, and there is a costly challenge of dealing with the solid waste from coal burning.[154]

The challenge to change perceptions: These perceptions affect the thinking of decision makers, and limit the development of renewable energy, but changing them is challenging. Changing widely held beliefs requires raising public awareness on the benefits of solar and wind power. Information on the negative consequences of coal and other fossil fuel use should also be made fully available. Media messages need to be short, clear and correct. The emphasis should be on the rapid reduction in the cost of solar PV and wind power, based on technology improvement and economies of scale. Solar PV and wind power are becoming cheaper than coal and gas power and even cheaper than hydro-electricity in some other countries. Coal power only appears cheap because social and environmental costs and risks are currently not included in the price, and there is a need for sound, hard evidence of the health and environmental impacts and economic costs, as well as risks related to dependency on foreign supplies of coal. Using imported coal and clean coal power technology (to increase efficiencies, reduce air pollution and improve waste management) makes it more expensive. Introduction of a carbon tax or fee (to charge for the environmental and health costs), and the phasing out of indirect subsidies would make the LCOE of coal power higher than the current FiTs for wind and solar PV in Viet Nam.[155]

III.2 Proponents of energy transition

Section I.2 provides an overview of the main stakeholders relevant to a socially just energy transition. This includes policy makers in the MOIT responsible for energy policies; other ministries responsible for environmental and social legislation; energy SoEs; private enterprises involved in renewable energy equipment and investment and operation of the first solar and wind energy facilities; Vietnamese NGOs as well as some researchers who are largely in favour of renewable energy transition; and the national media.

These stakeholder groups are not homogeneous and could be split in subgroups in order to characterize views, priorities and agency (influence or power)

when it comes to decisions regarding, for example: investment in coal-fired power plants or renewable energy generation; opening up to private domestic and foreign investment in the energy sector; measures to stimulate electric rail or road transport; increases in environmental or carbon tax and other policy measures to increase energy efficiencies; or measures to enhance access to energy and protect the poor from energy price increases. Agency is not limited to formal allocation of responsibilities and decision-making power, but can be enhanced or reduced in various ways, for example through research, information sharing and increased awareness, active lobbying and advocacy, and organized protest. It will normally be used to achieve the views and interests of the group concerned.

Table 6 gives a summary of the views, interests and agency or influence of different actors. This overview expresses the perception of the researchers as informed by the literature and 18 in-depth interviews with well informed individuals. Subjective, qualitative scoring was used in relation to the diverse opinions about and support for certain policy directions as well as the extent of agency of different stakeholders. The findings show clear trends in opinion and agreements between interviewees and written sources that we have summarized in Table 6.

The primary power over the energy sector lies with the mandated ministry, the MOIT. Most leaders and staff are still in favour of strong development of coal power and gas power, and they are sceptical about the potential as well as cost of non-hydro renewable energy, though perceptions are changing. The MOF, the MPI and the Office of the Government are also perceived as very influential because decisions such as those on large investments and energy prices have implications for public resources. These ministries also favour fossil fuel power, at least for the near future, though the MPI has somewhat greener credentials. The MONRE and the MARD are considerably less enthusiastic about coal-power and are more supportive of non-hydro renewable energy development. All ministries support the idea of development of a domestic manufacturing industry in the renewables sector, among others because of the potential for green and clean jobs.

Energy efficiency (EE) measures, including support to SMEs to improve their EE is widely supported by all stakeholders. But actual support is not overwhelming as Viet Nam remains energy inefficient,[156] and there is no obvious champion of the cause of improving EE across the economy. Support to EE may be strongest amongst NGOs, scientists, students and young people, international donors via ODA, and businesses, but these stakeholders have limited influence over key decisions such as national EE policies and programmes (e.g. the VNEEP) or fiscal policies (e.g. power tariffs, environmental taxes). The present practical financial and technical support to SMEs for improving their EE is indeed limited (see also section II.2).

Hydro-power is widely supported, but the potential for addition is limited to medium and small-scale power plants and micro-hydro generators at the household level. IPPs, that is, domestic private investors, continue to meet administrative and other challenges in connecting to the grid and initiating their projects.[157] Vietnamese and foreign private-sector investment in non-hydro renewable energy seems to be on the agenda of policy makers including provincial authorities, but the energy SoEs and their subsidiaries are not rushing this. Leading policy makers support new coal and gas fired plants more strongly,[158] though some leaders, including some provincial and environmental policy makers, lack enthusiasm for coal-fired power.

Energy SoEs have considerable agency and influence, and they clearly favour expansion of fossil fuel-based power, despite some initiatives in preparing non-hydro renewable energy plants. According to several observers, energy SoEs and especially EVN and its subsidiaries act in their own short-term interests, which are defined by their limited margins and their inability to raise tariffs:

a) They must receive the highest rates for the power that they produce, which explains a lack of enthusiasm for net metering of solar rooftop installations that reduce daytime peak consumption from the grid for which the higher power tariffs apply.
b) They must keep in use those established hydro-power and coal-fired power plants that represent sunk costs, and which provide cheap power.
c) They prioritize investment in gas and coal power plants as these have the cheapest up-front investment costs and for which cheap capital is

Table 6. Energy transition stakeholders' interests and relative influence (part 1)

`Acronym guide	
MOIT	Ministry of Industry and Trade
MOF	Ministry of Finance
MPI	Ministry of Planning and Investment
MOT	Ministry of Transport
MOC	Ministry of Construction
MONRE	Ministry of Natural Resources and Environment
MARD	Ministry of Agriculture and Rural Development
MOLISA	Ministry of Labour, Invalids and Social Affairs
EVN	Electricity Viet Nam
ERAV	Electricity Regulatory Authority of Viet Nam
VN	Viet Nam
VCCI	Viet Nam Chamber of Commerce & Industry
FDI	Foreign direct investment
ODA	Official direct assistance
NGO	Non-governmental organization
VUSTA	Viet Nam Union of Science and Technology Associations

available, underwritten by the government or foreign countries' entities.

d) They want private foreign operators to invest in power plants with relatively low upfront costs through turnkey or Build, Operate and Transfer (BOT) agreements. In both cases EVN subsidiaries will eventually take them on their books, increasing overall liabilities.

e) They aim for the cheapest form of power, including new hydro-power where possible, or *perceived* cheap power including coal, which has historically been cheap unlike non-hydro renewable power sources.

f) The LCOEs of different power sources are also an important consideration, but expenditure for coal or gas-powered plants happens throughout their economic lifetime whereas the upfront investment in renewable energy (RE) is by far the biggest factor in estimating the LCOE.

These pressures explain why solar PV and wind power may not be favoured by EVN subsidiaries, not even if LCOEs go below those of new gas or coal. Furthermore, internationally, non-hydro renewable energy costs are reducing steadily, especially solar PV, which according to some is a reason for the MOIT and other policy makers to move slowly instead of fast with regulations, which would allow it to wait until it is even cheaper. The same might apply to energy SoEs and some private companies or investors who have agreed on investment plans and possibly investment licences with local authorities already: they could postpone the actual start of projects, including equipment purchase, in the hope prices may fall. Beyond this, FiTs may be increased so that profits will improve.

Numerous project developers from Viet Nam and abroad have made investment agreements with authorities in different provinces to invest in wind or solar PV plants. International financiers, manufacturers and other businesses are interested in investing in gas power over coal power, in energy efficiency and in renewable energy, as shown in the Made in Viet Nam Energy Plan[159]. International businesses are promoting the possibility

Table 6. Energy transition stakeholders' interests and relative influence (part 2)

Supporting ... / Stakeholders	EE (energy efficiency)	EE aid to SMEs	electric transport	gas-power	coal-power	Non-hydro ren.en. (RE)	VNse private RE investment	FDI RE investment	VNse RE manufacturers	progressive power tariffs	climate change mitigation	Agency / influence
MOIT policy makers	++	+++	+	+++	++++	++	+++	++	+++	+	+	++++
MOF policy makers	+	+	+	++	++	+	++	+++	++	++	+	+++
MPI policy makers	++	++	++	+++	++	+++	+++	+++	+++	++	++	+++
MOT policy makers	++	+	+	+	+	+	0	+	+	+	+	+
MOC policy makers	++	++	0	+	+	++	+	+	+	+	+	+
MONRE policy makers	++	++	++	++	+	+++	++	+++	+++	++	+++	++
MARD policy makers	++	++	+	+	0	+++	++	++	++	++	++	++
MOLISA policy makers	+	+	NA	+	+	+	+	+	++	+++	+	+
Office of the Government	+	++	+	+++	++	++	++	++	+++	++	+	+++
National Assembly members	++	++	+	+++	++	++	++	++	+++	+++	+	++
Provincial / City authorities	++	++	++	+++	+	+++	+++	+++	+++	++	+	++
Coal, Petroleum SoEs	+	0	0	++++	++++	0	0	NA	0	0	0	++++
EVN generation companies	+	0	+	++++	++++	+	+	+	+	0	0	++++
EVN distribution companies	+	++	+	+++	+++	+	+	+	+	0	0	++++
EVN – other companies	++	++	+	+++	+++	++	++	++	++	+	+	++
ERAV	++	++	+	+++	++	++	++	++	++	++	+	++
VNse private industry	++	++	+	+	+	++	++++	++	++++	+	+	+
VNse financiers/commercial banks	+	+	0	++	++	+	+	+	+	0	0	+
VN Development Bank & VEPF	+	++	0	+	0	++	++	0	++	+	+	+
VCCI, business associations	++	++	+	++	+	++	+++	++	++	+	+	++
FDI manufacturers	++	++	++	++++	++	++++	++	++++	++	+	++	++
FDI financiers	++	++	++	++++	++	++++	++	++++	++	+	++	++
ODA (loans & Technical Assistance)	+++	+++	++	++	+	++++	+++	++	++	+++	++++	++
Institutes, researchers	++	++	++	++	+	+++	+++	+++	+++	++	++	++
NGOs, VUSTA	+++	+++	+++	++	0	++++	++++	+++	++++	++++	++++	+
Energy experts, consultants	+++	++	++	++	+	+++	+++	+++	+++	++	++	+
Urban well off	++	++	++	++	+	+++	+++	++	+++	++	++	++
Students, urban young people	+++	++	+++	++	0	++++	++++	++	++++	++	+++	+
Low-income households	++	NA	++	+	+	+	+	0	++	++++	+	+
Farmers, fishermen	++	++	+	+	+	++	++	0	++	++++	+	+

LEGEND — *Supportive of <issue>: Agency/Influence*

0 *no support; no agency/ influence* | **+** *limited support; little agency/ influence* | **++** *reasonable support; reasonable agency/ influence* | **+++** *strong support; influential player* | **++++** *very strong support; a dominant force* | ***NA*** *not applicable; no opinion*

Box 6. Piloting solar PV net metering, crediting and direct PPA in HCMC

The Ho Chi Minh City (HCMC) high-tech industrial park has proposed to the People's Committee to promote solar power at the park, by allowing companies to connect solar PV systems to the grid with a system for two-way metering and crediting, and to assist in getting licences for solar power projects, including for direct PPAs. The Energy Conservation Centre of the Department of Science and Technology (DOST) of HCMC will assist firms, buildings and households in the park to install a total up to 1 MW/year and to buy solar power at 2000 VND/kWh (9 US$ cents/kWh).

Box 7. Biogas Program in the animal husbandry sector of Viet Nam

The biogas programme of the Livestock Production Department of the Ministry of Agriculture and Rural Development (MARD) and the Netherlands Development Organisation SNV claims major achievements over the period 2003 to early 2017, as follows:

– Facilitated the construction of nearly 160,000 domestic biogas digesters, benefiting nearly 800,000 rural people across 55 provinces and cities of Viet Nam

– Created more than 2,500 new jobs

– Trained nearly 1,700 biogas masons and supported 355 biogas construction team leaders

– Provided training to nearly 165,000 households

– Reduced around 800,000 tonnes of CO2 equivalent per year, made substantial improvements in local sanitation, produced liquid fertilizer, and improved convenience of cooking

– Developed a dynamic biogas market

– Was awarded with 1,290,876 carbon credits under the Gold Standard Voluntary Emission scheme

– Won the Energy Globe Award in 2006, the Ashden Award in 2010, and the Humanitarian Award at the World Energy Forum 2012.

(Sources: Schaart 2010; Vu Dinh Ton et al. 2013; http://www.biogas.org.vn/english/Introduction.aspx and http://www.snv.org/project/vietnam-biogas-programme)

of connecting rooftop solar PV systems to the grid and reducing their power bills through net metering. They also favour direct PPAs, where a business would invest in power plants and sell directly to certain customers, compensating the EVN group power distribution companies for use of the grid. International businesses want to target large foreign-invested companies that are committed to making their global operations low-carbon or even 100-per cent renewable. There is no regulation on direct PPAs in Viet Nam yet; and EVN subsidiaries may feel that they would lose large power customers, so they may not want the government issuing such a regulation. There is, however, a pilot net metering program, as shown in Box 6.

International development partners have very similar views to international businesses, and are promoting wind power and solar PV as well as biofuel and energy efficiency.[160] However, their influence over key policy decisions such as the regulations to stimulate wind and solar PV is limited.

Vietnamese and international NGOs have achieved local successes in promoting renewable energy and energy efficiency. Standing out in this regard are the Biogas Programme for the Animal Husbandry Sector of Viet Nam, of the Livestock Production Department of the MARD with technical assistance from SNV (see Box 7), and the LEP initiative by GreenID in a number of provinces (see Box 8). These demonstrate the viability and multiple advantages of different technologies in the lives of people, and with small but potentially significant cumulative national and international benefits. NGOs including the VSEA also do policy analysis and advocate for energy efficiency and renewable energy,[161] e.g. on national power planning.[162]

Policy support to development of the Vietnamese renewable energy manufacturing industry, as characterized in Table 6, is evidenced by provisions in for example the Renewable Energy Development Strategy (REDS).[163] Policy makers are concerned that instead of Vietnamese companies, the benefits from renewable energy development would go to foreign companies.

Box 8. Local energy planning in Viet Nam

GreenID has supported Local energy planning (LEP) in communes across Viet Nam. This approach promotes sustainable energy development with local participation in planning and application of different, decentralized renewable energy solutions. Local people and authorities work together on a common plan to address energy as well as the local environment, health and livelihoods, with support from experts. The approach also engages policy makers at higher levels.

After local planning, demonstration models are set up by households that are willing to invest something themselves, and who receive 20-50% of total investment cost as support. GreenID helped households to negotiate with private companies providing energy solutions to ensure affordable prices and best quality. GreenID also helped to organize workshops with potential sponsors and policy makers at provincial level to seek their support for the implementation of local plans.

Some households as well as health posts, kindergartens and schools applied biogas digesters, water heaters, efficient cook stoves or reverse osmosis water purifiers and supply systems that use solar PV. LEP has brought economic, social and environmental benefits to people in several communities, especially women, including:

– Reduced fuel costs for households

– Reduced energy cost for authorities (services) and the community

– Markets and jobs for sustainable energy production

– A cleaner environment

– Health improvements

(Sources: CCWG 2015; http://greenidvietnam.org.vn/)

Some Vietnamese-owned companies have already emerged even without obvious government support (RedSun and Solar BK are examples of Vietnamese private enterprises in the solar PV market, currently focusing on export of equipment – see Box 2). Vietnamese renewable energy manufacturing businesses may be small in size and number, but there is confidence that they can deliver and grow fast if the domestic market changes. They are themselves a voice in favour of broadening their opportunities, but they are not influential. Nevertheless, favourable regulation and incentives, for example in the form of tax rebates, for the national manufacturing industry is supported by most stakeholders. Viet Nam is also home to manufacturing facilities of foreign enterprises (solar panels, wind towers) who produce for export but are interested in selling on the national market as opportunities arise – and they would want the same advantages as nationally owned enterprises on, for example, taxation (see Box 2). Foreign investors only somewhat endorse the idea of support for domestic industry, as they aim for the cheapest and best technology, and would not want to be limited to made-in-Viet Nam equipment. Energy SoEs appear only marginally supportive of developing domestic manufacturing capacity, perhaps because they do not yet have stakes in that themselves.

The Vietnamese authorities generally support poor people and special social groups, and are open to improvement of mechanisms to limit the effects of high energy costs on income and well-being. The support for a more progressive IBT is strongest in the Ministry of Labour, Invalids and Social Affairs (MOLISA) and weakest in the MOIT and among energy SoEs, as many in the latter see this as social policy that is not the responsibility of the electricity sector.[164] Support for a progressive IBT is also found amongst some National Assembly members, NGOs, some experts and research organizations as well as international development agencies, but it is muted or weak amongst private sector stakeholders.

The reduction of GHG emissions for climate change mitigation does not feature prominently in the views and interests of most stakeholders. Policy makers of the MONRE and MPI support climate change action more than other policy makers. NGOs, students and young people and some experts, as well as international stakeholders, also support mitigation action, but have limited influence. The energy SoEs are unsupportive or lukewarm in their support for GHG emissions reduction and do not consider this to be in their direct interest or their responsibility. They are, however, very influential regarding policy and investment in non-hydro RE.

Agency is about formally allocated responsibilities and decision-making power as well as the strength of arguments. Vested interests may be protected by influential actors, but stakeholders may be open to changing their views when presented with convincing arguments. Evidence that things can work makes a difference. The possibility of low costs and high efficiencies, for example, can sway decision makers in private or public financial circles. Those with limited agency such as small enterprises, NGOs and experts or researchers can influence major decisions if their analysis and communication is convincing, repeated, and consistent with the views of others. This has started to happen in Viet Nam, where there is consistency between various sustainable energy scenarios,[165] a survey of views on solar PV development by industry experts,[166] views of key development partners in association with national experts and researchers,[167] and the positions of NGOs.[168] Nonetheless, major changes have not yet been achieved. Information is being communicated to policy makers and other stakeholders but vested interests are strong. The demonstrated success of some scaling-up efforts, as in the case of household-level biogas digesters, has convinced some authorities (e.g. MARD). But there is no comprehensive biogas support framework in the energy sector, such as in the case of wind energy. Popular protest against pollution as reported in section II.4 coincide with evolving views of some provincial authorities and National Assembly members, who all have relatively limited agency and have not changed the dominance of coal and gas in power supply plans and petroleum products for transport plans. However, a recent example of feedback from the coastal zone province of Bac Lieu led to the withdrawal of a coal-fired power plant from official plans, which does suggest that the Prime Minister and other central authorities are sensitive to arguments against pollution and in favour of expansion of RE, in this case wind power.[169]

IV. Viet Nam-specific characteristics

Some specific characteristics may influence the process of an energy transition in Viet Nam:

First, most policies in Viet Nam are set and implemented in a top-down manner. The government (the executive branch) sets and implements specific policies. The National Assembly monitors the executive and develops and adopts laws that are ultimately agreed to by the president. But the Communist Party sets overall policy directions. This guidance includes that Viet Nam should not pursue growth regardless of any environmental cost, and it must respond to the threat of climate change.[170] Recent increases in public environmental awareness due to pollution cases enhance this sentiment. Further raising the awareness of key Party members about the energy transition and the economic, social and environmental costs of coal power compared to the advantages of renewable energy as well as energy efficiency may have a significant impact on the speed of the transition.

Second, Viet Nam's development has been strongly dependent on natural resource exploitation. The mining sector contributed 9-10 per cent of GDP over the past decade; petroleum revenue increased from zero in 1986 to more than 11 per cent of GDP in 2005 and around 4 per cent of GDP in 2014. The fossil fuel sector of coal, oil and natural gas is thus important, and has a large associated network of actors and institutions. Although the recent decrease in oil and coal reserves and a drop in world prices challenges Viet Nam's dependency, this history still influences the mindset of many, and therefore the energy transition in Viet Nam.

Third, while many countries, including China, South Korea, and Japan, are banning or reducing investments in coal power, their equipment manufacturers, project developers and investors are moving to Viet Nam where they find a market. Some expert interviews also highlighted that coal-exporting countries are encouraging Viet Nam to expand coal power production. By one report there is nearly US$ 40 billion FDI in coal power generation in Viet Nam, an estimated 50 per cent of which is China-invested, 23 per cent Japanese and 18 per cent from South Korea.[171] These investors understand the Vietnamese system and practices and know how to realize their investment in Viet Nam. It should however be stressed that these countries are amongst the biggest foreign investors and that their FDI also includes renewable energy equipment manufacturing facilities (see Box 2), and developers from these countries are also exploring investments in renewable power production (see Box 3).

Fourth, Viet Nam's annual GDP growth has declined compared to the previous decade, from 6.8 per cent during 2001-2010, to 5.8 per cent during 2011-2015. It was at 6.2 per cent in 2016 and is projected to be around 6 per cent in 2017. Public finance is also under pressure, with the National Assembly having set a limit on public debt, so public capital investment is increasingly scarce. In addition, as Viet Nam became a lower middle-income country in 2010, it will no longer benefit from preferential loans from the World Bank. In this context, Viet Nam needs private investments that push economic growth, in particular investments associated with technological innovation. The government expects to mobilize both domestic and international private capital. Investment in non-hydro renewable energy equipment manufacture and deployment for power generation both fit these goals and imperatives.

V. Conclusions and recommendations for a socially just energy transition in Viet Nam

Viet Nam can boast of some achievements towards a socially just energy transition, such as the high percentage of households with access to electricity. But it lags in other areas, including on energy efficiency and non-hydro renewable energy deployment. Viet Nam is urbanizing rapidly, and power production, transport, manufacturing and the construction of residential and commercial buildings are expanding at a high pace. This change could increase inefficiencies and offers an opportunity for a low-carbon future. It is critical to avoid sinking costs into high-carbon power plants and inefficient facilities and infrastructure and locking the country into a future of using them, and to ensure that Viet Nam moves to a low-carbon future.[172] An energy transition can be socially just with benefits to the country and its people. More use of renewables and greater energy efficiency would contribute to improving the quality of energy services, creating jobs, modernizing industry, increasing economic efficiency and growth, improving the local environment and helping mitigate global climate change.

Hydro-power is currently the main renewable energy source and it has some additional scope, including pumped storage, but future potential renewable energy in Viet Nam is mainly solar, wind and biomass. Solar heating and biogas cooking and heating have good potential, and liquid biofuel production can also be expanded. However, the main renewable energy development potential is through solar PV and wind power and also biomass, including waste-to-electricity. Energy efficiency in the manufacturing industry, agriculture, buildings, households, and transport have further substantial scope for improvement. Electric transport has started in Viet Nam in the form of e-bikes, and is a global trend that Viet Nam can benefit from through pro-active engagement.

Large-scale deployment of renewable energy, improvement of energy efficiency, and electrification of transport will only happen if the main challenges are addressed and if the co-benefits are fully appreciated, i.e. employment, environmental health, energy security, climate change, etc. A socially just energy transition requires some fundamental changes, as well as practical, small but numerous changes and initiatives. There will need to be reform of different segments of the energy sector.[173] The following are suggestions for addressing the main challenges and turning the energy transition into multiple opportunities.

V.1 Develop a new long-term energy vision

Change starts with a long-term vision. Viet Nam's present official energy sector vision, partly explicit in current policies and partly implied, is a future of large-scale, centralized power plants mostly running on fossil fuels; expansion of oil and gas exploration as well as coal mining if possible, and growing fossil fuel imports; a transport sector almost completely dependent on petroleum products, though with strict emissions standards; cooking and heating primarily dependent on fossil fuels; manufacturing, agriculture and fisheries using a mixture of fossil fuels and electricity; and complete penetration of the national grid, also in the remotest communities and near-mainland islands.

An alternative vision should fully appreciate the public co-benefits of renewables and energy efficiency, and maximize long-term national welfare. It should be consistent with Viet Nam's international commitments, including achieving the Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development and the Paris Agreement on climate change.[174] These require high ambition to improve energy access and energy efficiency, reduce GHG emissions, and possibly move to 100 per cent renewable energy, with the latter agreed as a long-term goal of climate vulnerable countries including Viet Nam.[175] This alternative vision is one with very high energy efficiency in all sectors; dominance of renewable energy in the national energy mix; and many decentralized,

distributed power producers including prosumers. This would mean a heterogeneous and interconnected electricity system; strong electrification of transport; and very limited dependency on energy import, mining and transport of fuels.[176] Depending on implementation, the alternative vision could reduce energy costs to consumers and increase GDP growth, create local value chains, provide more jobs in the energy sector, support the poorest and remotest communities and households in accessing energy, and enhance development of new industries, when compared to the BAU scenario. It will undoubtedly lead to a cleaner environment and support global climate change mitigation.

The alternative energy vision should be reflected in relevant policies, strategies and plans, including policies that are currently being prepared such as the new National Energy Strategy, and the Renewable Energy Action Plan roadmap. This will require dialogues between policy makers and many stakeholders in the energy sector.

V.2 Ensure a major shift in investment focus

Some measures may not require large investments. Energy efficiency can often improve with modification of rules and habits, i.e. through behaviour change. Other efficiency measures do require large investments with long-term effects on manufacturing, transport, buildings and consumer appliances. But "large" must be understood in relative terms: households, companies and institutions must all somehow be encouraged to invest. If they do so, they will see multiple benefits.

To achieve the alternative vision, investments must especially be shifted to renewable energy production, with a focus on solar (PV and heating, at different scales); on-shore, near-shore and off-shore wind power; and biomass-based power, heating and cooking. Investments are needed in energy storage capacity (pumped storage, including re-engineered existing hydro-power facilities; and battery storage, including the national car fleet as technology to connect with the grid will be applied), as well as development of the smart power grid to manage both demand and supply. In the near future there is a key role for natural gas, for cooking, industrial heating and power production, as an immediate alternative for any coal expansion.[177] Gas exploration, transport and use has considerably less impact than coal on climate change, environments and livelihoods – it is also being promoted by international businesses.[178]

Finance for electricity should mainly come from the private sector, without an excessive degree of leveraging of energy SoEs. Also important is that significant investment should be encouraged into rooftop solar PV by prosumers, businesses and households who feed excess power into the grid but are usually net consumers who thus reduce their electricity bills. Small-scale distributed power producers (businesses, communities or cooperatives) might deliver to local mini-grids or the national grid, or sell directly to specific large customers, paying a fee to the power distributor. Such direct PPAs can cumulatively become a highly significant private investment – and distributed power production means that transmission and distribution losses of the system will be limited compared to the present conventional centralized power production system.

Advocacy for the alternative vision and shift in investment should convince the sceptics and target those who represent vested interests and resist the energy transition. It should be based on strong evidence with practical demonstrations. The key messages include the following:[179]

a) Energy efficiency can pay itself
b) Electric transport has many advantages, and is the future
c) Renewable energy can be comparatively cheap instead of expensive, even without counting the environmental and social costs of fossil fuel use
d) A carbon fee or tax on fossil fuels would speed up the energy transition and would be good for public finance. Any (temporary) negative effects on low-income consumers could easily be addressed
e) Renewable resources are plentiful instead of scarce
f) Renewable energy can benefit the poorest and most remote communities, farmers, as well as urban households and industry

g) Renewable energy can provide a part of "baseload" instead of causing power-grid instability
h) Renewable energy and energy efficiency reduce energy dependency and recurrent costs
i) Rrenewable energy and energy efficiency create jobs and can help generate modern industry
j) Renewable energy and energy efficiency help improve the local environment
k) Renewable energy and energy efficiency reduce the threat of climate change

V.3 Improve SoE transparency, competition and regulation

There is a need for increased transparency of the energy SoEs and their subsidiaries, including financial and technical details, as citizens of Viet Nam are effectively majority shareholders of these companies through the state. There is a popular perception of inefficiencies in delivering energy services by monopolies such as EVN, but citizens cannot really find the facts, which erodes trust.[180] Public transparency, for example about actual production costs of power plants, could enable a societal dialogue about policy and implementation. Importantly, there is in fact high level support for more transparency.[181]

Competition in the petroleum product sector is still weak and could improve efficiencies and benefit consumers. It has been suggested that the government should formulate and implement a policy framework to enhance competition in downstream petroleum product markets, including a breakdown of Petrolimex's vertical integration (import-export, distribution, marketing, retail) and horizontal integration, and to support independent participants in marketing and retail.[182]

Many agree that the power sector reform process should continue. The reform aims for efficient power production and distribution, with ultimately competitive and low consumer prices.[183] Achieving this will require the real break-up of EVN and the introduction of many regulations on competition. ERAV must become independent and get a stronger regulatory charter to promote electricity markets and a financially sustainable electricity sector, and it needs sufficient powers to be able to sanction market participants who contravene agreed standards. In addition, the goals of a growing share in renewable energy and energy efficiency must be added into the power sector reform process. Ensuring that competitive markets also deliver on energy efficiency and renewable energy requires different policy instruments, including renewable portfolio standards. This means that large power generation companies (GenCos) such as subsidiaries of EVN and PVN are given a roadmap on how much non-hydro renewable energy they must minimally produce per year – a percentage that would increase steadily (see also Figure 2).[184] This incentivizes them to seek the cheapest form of renewable energy, including wind power, solar PV and co-firing of biomass in existing coal-power plants.[185] Compliance should be monitored and enforced by ERAV.

V.4 Fiscal policies to promote renewable energy and energy efficiency

Viet Nam's low and indirectly subsidized energy prices are a barrier to improving energy efficiency and stimulating renewable energy. The phasing out of indirect subsidies, primarily in the power sector, and the introduction of carbon fee or tax, affecting power, manufacturing industry as well as transport, will lead to an increase in consumer prices, for which there is little political and popular support. However, fossil fuel subsidy phase-out and a carbon tax should lead to scaling-up and increased efficiencies of renewable energy, leading to medium and long-term cost reductions. Furthermore, higher prices are also likely to occur in the fossil fuel-intensive BAU case, and that may not be just temporary.[186] Therefore, in both the BAU scenario and low-carbon scenarios, an increase in energy prices should be expected, which has disadvantages for low-income households and certain businesses that can and must be dealt with.[187]

The prices of petroleum products and electricity tariffs are controlled by the government, with the former regularly being adjusted in response to changes in world market prices. Cost-based power tariffs, and transparent and predictable electricity pricing are critical according

to different observers and would eliminate the need for indirect public sector support. This would result in a phasing out of indirect subsidies.[188] As competition in the power sector will increase step by step because of power sector reform, tariff increases should be limited and reductions may be expected; similar steps towards fully competitive petroleum product markets have not yet been taken.

In addition, environmental taxes are low and a carbon tax or fee on fossil fuels (or a carbon price generated by an emissions cap-and-trade scheme) does not exist yet – but it would internalize the costs of the exploitation, transport and use of fossil fuels on health, local livelihoods, the environment and climate change. A carbon fee is mentioned in the 2015 REDS,[189] but implementation is not yet being prepared. Phasing out indirect subsidies, increasing environmental taxes, and introduction of a carbon tax of fee would free up public resources and possibly add some state revenue, depending on how revenue from a carbon fee is allocated.

More expensive petroleum products and cost-based power tariffs have negative impacts on low-income households' expenditure, especially in the short term. However, these households can be protected from rising energy costs through a reformed, more progressive incremental block tariff scheme for electricity, as current cash transfers are inefficient.[190] Energy prices that rose by about 15 per cent in real terms (in small incremental steps, e.g. over a period of three years: see section II.2) would send a clear signal to most households and businesses to improve energy efficiencies in production, transport, and appliances. Support programmes for SMEs to improve energy efficiencies exist but must be scaled up and publicized better.[191]

Higher power tariffs (by possibly 15 per cent in real terms, in steps) will make distributed power production with for example, solar PV on rooftops more attractive. This fiscal policy change should stimulate private investment in renewable energy at different scales. And as solar PV and wind power scale up, national manufacturing and renewable energy project development capacities will increase. With competition, costs are expected to reduce to well below the costs of a coal and gas-dominated power sector. This would deliver lower electricity prices over the period to 2050 when compared to the BAU scenario dominated by fossil fuels, according to the model in a study (see section II.2).[192]

V.5 Regulations to realize renewable energy and energy efficiency

Viet Nam has made some progress with energy efficiency, through the VNEEP and some international projects that have helped technology renewal, for example for: gas-fired kilns for pottery and brick making; building energy efficiency standards and techniques; development of domestic industry to produce compact fluorescent lamps and light-emitting diode lamps; energy efficient public lighting; and energy efficiency labelling. But further standards and support mechanisms are needed.[193]

For the development of renewable energy, a substantial amount of technical and administrative regulation is needed. Developments are slow and international agencies could provide additional support to this. The REDS of 2015 will be operationalized through the Renewable Energy Action Plan ("roadmap") that is being developed but not yet issued; yet, only the implementation of this Action Plan will make things happen in practice. The solar PV support Decision of April 2017 also requires that detailed and practical regulations be issued; and other RE support policies must be amended to become fully effective. The following are examples of regulatory measures that are needed for an energy transition, all of which provide practical details to directions set out in the REDS:

- The Renewable Energy Action Plan must ensure that the complex process of licensing of renewable energy power plants will be streamlined. Project developers must reach agreement with the Provincial People's Committee, for which their plans must be consistent with the existing provincial electricity plans (under the provincial Department of Industry and Trade) and Land Use Plans (provincial Department of Natural Resources and Environment). If these plans must be adjusted permission is required from ministries

in Hanoi. Only then can a provincial Department of Planning and Investment issue licenses.

- The Renewable Energy Action Plan might decide how and when guidance will be issued on co-firing of biomass in coal-power plants.[194]
- An increased wind-power FiT has been discussed over the past years, but has not been issued yet, which would be necessary to speed up investment; this could also regulate the phase-out of the current subsidy by the VEPF.
- There is also a need for regulation on "maximum FiTs" and mechanisms for gradually driving investment costs down, notably auctioning of the right to invest in certain installed capacities and sites of solar or wind power, but these have not been accepted or regulated yet.[195]
- There is a need for a standardized PPA for solar PV farms, and the legal enforcement/quality of other standardized PPAs should be improved. Direct selling from producer to customer should be made possible (direct PPAs), which is consistent with power sector reform (which is moving towards competitive electricity retail markets).
- There is a need for technical standards and regulations on (simple) administrative procedures to make sure that net metering for different types of grid connected rooftop solar PV systems will be possible and practical (businesses, households, and communities).
- There is a need for regulation on Renewable Portfolio Standards, proposed in the REDS (how much RE in the GenCos' power production mix, and by when?).
- The Renewable Energy Action Plan must decide who will formulate and manage the carbon fee on fossil fuel use and the Renewable Energy Fund that is proposed in the REDS.
- Enforcement is needed of policies and rules on the use of biofuels in transport.

V.6 Capacity building for renewable energy and energy efficienc

Many different capacities must be increased for Viet Nam's socially just energy transition. Capacity gaps and capacity building requirements include the following:

- Capacity building and training in communication skills on renewable energy and energy efficiency of NGO workers, youth organizations, to (ultimately) target persons with influence. This should also be mainstreamed in curricula of schools and universities.
- Skills of ERAV, MOIT and local authorities for monitoring and enforcement of regulations on renewable power should be strengthened.
- The National Power Dispatch Centre and electricity distribution companies need sufficient numbers of well-trained technical staff to be able to manage a transition from a limited number of large scale power plants to a complex system with distributed power generation by diverse power sources.
- Transition also requires investment in physical capacities, i.e. high voltage grid and low voltage distribution networks as well as equipment such as "smart meters".
- MOIT's Energy Efficiency and Conservation Office should be strengthened.[196]
- Awareness of basic energy efficiency measures in households and businesses must be raised.
- Banks and their investment officers should be trained in the business risks and potential profitability of energy efficiency and renewable energy investments, also in rural towns where loans could enable measures at small and medium business premises and systems owned and managed by cooperatives of farmers.
- "One-stop-shops" must be set up in power distribution companies across the country, to enable solar PV "prosumers" to register, install and connect systems for net metering, and (local) EVN personnel must apply/monitor grid connections as per technical standards, which will require training.
- In remote rural areas, grid-connected or off-grid solar PV could be very beneficial given the frequency of blackouts and long distances that raise costs of the distribution network and transmission of power, as losses increase with distance. Other sustainable energy solutions could also be very beneficial in remote communities. For this, awareness raising of households, communities and businesses in remote areas is needed, possibly using the LEP approach as applied by GreenID (see Box 8). This may require training of local technicians in installation and O&M.

- Equipment manufacturers and traders, and companies doing installation and O&M will respond to new commercial opportunities, develop their capacities, and upscale. But the first experiences with erecting wind towers and installing turbines showed that there are very few companies with the required equipment such as large cranes and construction management skills. Low cost technical advice from development agencies would enable the first large investments in solar and wind farms.
- The main development agencies could also provide technical assistance for building certain capacities of the emerging Vietnamese manufacturers of renewable energy equipment and their personnel, as well as Vietnamese project developers and managers. At a local level, much of this has happened regarding household scale biogas (see Box 7), and solar water heaters are widespread already, with multiple (local) brands on the market. But few have expertise in the manufacture of different components of solar PV systems or wind turbines and management of solar PV and wind power investment (construction) projects.

V.7 Reaching out to remote communities and other target groups

A useful framework for setting priorities for policy advocacy as well as practical actions is the 2030 Agenda for Sustainable Development, and specifically SDG 7 *"Ensure access to affordable, reliable, sustainable and modern energy for all"*.[197] SDG 7 targets for 2030 are: universal access to energy services, a substantial increase of renewable energy in the global energy mix, and doubling of the global rate of improvement in energy efficiency. Priorities of NGOs or development agencies for active, practical engagement towards a socially just energy transition in Viet Nam would include ethnic minorities, migrants (who often pay informal, high energy prices), workers in low-paid and labour-intensive industries, and women. Poor rural people and urban migrants and workers could benefit from renewable energy and energy efficiency measures in different ways.

Improved energy access is often a pre-condition for poverty elimination. It could include improved cooking stoves, biogas digesters, solar water heaters and off grid power generation, as well as local mini-grid and on-grid power supply and distribution systems. Experience in remote communities shows that power volumes consumed are low and the use of firewood and agricultural by-products for cooking may continue, affecting the environment. This is prompting active support to biogas generation and other solutions, but low-cost RE system maintenance and repairs may pose problems. The LEP approach (see Box 8) is targeting women and has demonstrated results, for the women who were actively engaged as well as their wider communities.

Large, labour intensive factories (such as the textile or footwear industry in Viet Nam) with solar PV rooftop systems and batteries for backup as well as energy efficiency measures are likely to save costs on energy, provide better conditions for workers (for example: uninterrupted fans for cooling), and improve competitiveness because production will not be disrupted by blackouts. This RE technology thus also makes such labour-intensive factories possible in remoter areas. Small enterprises and cooperatives can be provided new opportunities for wealth and employment generation in rural areas through regulation that enables them to invest in on-grid power sales from small solar PV systems or single wind turbines, or for example enhanced demand for agricultural residues for heating and power generation. But such regulation is not currently being prepared, so apart from practical engagement, advocacy for appropriate regulation would also be needed.

V.8 Policy dialogues and demonstration of success

Energy policy is made and decided through exchanges and processes within and between the Party, Government, the National Assembly as well as provincial authorities. Linking to that and possibly influencing that from the outside are broadly four communities (see section I.2 and III.2 and Table 6). Each somehow engages in policy dialogues on energy development in

Viet Nam, though usually informal and indirect, and only partly in a public manner and through the media. FES and other international agencies could link to those communities in different ways, and support dialogues with members of the Party, Government, the National Assembly and provincial authorities, in particular dialogues based on research and practical successes. These four communities are as follows.

The first is the community of **Vietnamese energy professionals**, who work in the central and local Government, energy SoEs and private enterprises as well as research organizations. Many individuals are members of or linked to the Viet Nam Energy Association (VEA); and state owned and private national businesses are associated in the VCCI and other associations. VEA shares information and analysis on conventional energy development as well as renewable energy and energy storage. Members contribute articles to the website, including a series of 14 articles in early 2017 on why Viet Nam needs to develop coal-power, as well as articles on environmental problems of coal-power plants and advantages of wind power and other renewables. It includes many news items on developments in Viet Nam as well as the rest of the world.[198] Many of the professionals were educated at a small number of universities such as the Electrical Power University,[199] HCMC University of Technology (Bach Khoa University, BKU),[200] and the Hanoi University of Science and Technology (HUST).[201] Some work at these universities or at research institutes such as the Institute of Energy (IOE, under MOIT but formerly under EVN) and the Viet Nam Petroleum Institute (under PVN).[202]

The second community is of **Vietnamese as well as international NGOs** based in Viet Nam. Proponents are partly overlapping with the energy professionals (VEA, research organizations and universities) and include some young as well as retired energy professionals and researchers. Important is the recently created the VSEA that has organized the "Viet Nam renewable energy week" (in different parts of Viet Nam), and coordinates some publications by alliance members.[203] Vietnamese NGOs in the VSEA may be registered under the VUSTA, which is an officially recognized body with members throughout the country working on a wide range of (science-related) issues, including biogas digesters.[204] The VSEA works with other groups and alliances of NGOs in Viet Nam's emerging civil society, on air pollution with the Viet Nam Non-Communicable Diseases Prevention Alliance (NCDs-VN) and with the Climate Change Working Group under the NGO Resource Centre.[205] Members also cooperate with local authorities and central agencies such as the IOE.

Their "authority to speak" about policy is grounded partly in their professional background (as is the case for VEA members), partly in the results they have gained with community development projects such as those using LEP (see Box 8), and partly in research on specific topics such as the environmental costs of coal-power. Some in this community have a history of engagement with the development of large dams, especially in the Mekong River Basin and the Red River Basin, i.e. Viet Nam's two large international rivers. Negative effects of inappropriate dam construction have been reported in the public media (such as the Song Tranh 2 dam, built on a geological fault line and causing local tremors) and operation (e.g. sudden extreme releases of water without proper prior warning of downstream populations).[206] Much concern in Viet Nam and neighbouring countries has been raised in recent years over large dams that are being built and planned in the mainstream of the Mekong River in China, Laos and Cambodia, which affect biodiversity and reduce dry season river flow, affecting livelihoods that depend on fishing and agriculture.

A third community is made up of international "Development Partners" including bilateral and multilateral development banks (such as the World Bank, Asian Development Bank, the Japan International Cooperation Agency (JICA), KfW, Korea Export Import Bank, the French Development Agency AFD); technical assistance agencies such as the UNDP, GIZ, AECID and the Belgium Technical Cooperation agency BTC; and embassies with small funds for technical assistance and a mandate to encourage trade and investment in energy and related equipment. Development Partners have entered into the VEPG with the Government, led by MOIT, aiming "to work towards effective and efficient international support to sustainable energy

development in Viet Nam, in line with national law and international agreements of which Viet Nam is a member". This will include technical working groups and policy dialogues in the context of the 2030 Agenda for Sustainable Development (i.e. the SDGs) and the Paris Agreement on climate change. The VEPG is expected to invite representatives of NGOs and businesses as well as research organizations to policy dialogues and technical working groups, i.e. representatives from the other three communities highlighted here.

The fourth community is of V**ietnamese and foreign invested businesses**. The VBF organizes dialogues with Viet Nam's leadership on a wide range of topics including energy.[208] The Vietnamese co-chair is the Chairman and President of VCCI and the international co-chair rotates. It is coordinated by a consortium of international and local business associations and chambers of commerce. It has 11 working groups, of which the Infrastructure Group has a Sub-Working Group on Power and Energy.[209] Groups of businesses in certain sectors and specific chambers of commerce and business associations may also seek separate exchange and dialogue with policy makers on specific topics through for example focused (and sponsored) workshops, which has happened on technology and policy related to wind power and solar PV.

VI. Recommendations for the FES office

VI.1 Studies

Commission studies that address limitations in present knowledge and understanding, that help address pertinent, specific challenges in renewable energy transition and that could create breakthroughs. This should be done together with others, possibly with international experts and certainly with national organizations that have or can generate links with decision-makers at different levels, such as IOE, BKU (HCMC) and HUST. Such studies should be led by top-experts on relevant subjects. For example, the following:

1. Study the employment situation in the energy sector, including coal mining and transport, power production as well as manufacture of equipment, installation, operation and maintenance of power facilities and distribution and transmission infrastructure, including occupational health conditions, worker pay and insurance, gender differentials, etc., to improve understanding of employment opportunities that could come with an energy transition.
2. Study the institutional, regulatory and practical (capacity) challenges and opportunities for the use of renewable energy in poor, remote communities. This could concern off-grid solutions such as what is being rolled out by KEXIM in Quang Binh province (remote border villages) (Box 3), mini-grids such as what GreenID is developing in An Giang province near the border with Cambodia, possibly hybrid systems with hydro-power generation, and grid-connected solar PV, wind, biogas or other solutions. This study should also explore the potential for capacity building approaches at community level.
3. Study the international challenges and opportunities for energy transition, in particular vis-à-vis Viet Nam's immediate neighbours. Viet Nam is an investor in Cambodia and Laos, also in the energy sector; it imports power from China; and most FDI into the energy sector is from China. Viet Nam may seek to reduce the number of future dams in the Mekong river basin because of multiple negative effects on the Mekong Delta, and can help to identify dam sites with lower impact. It can also promote investment in non-hydro renewable energy, increase transmission linkages with Laos and Cambodia, and purchase non-hydro renewable power: wind and solar PV generated and traded across internationally interconnected grids can be highly efficient and intermittency becomes less challenging (there is always wind somewhere in a larger region). Opportunities might also be found in job-creation, and reduction of risks and negative effects on hydrology, ecosystems, fishery, and agriculture based livelihoods.

VI.2 Campaigns

Support campaigns to raise awareness of the wider public and targeted professionals of specific advantages of energy transition, and advocate policy and practice changes with decision makers.

Awareness raising should target those already open to energy transition such as urban youth and well-off groups, researchers and energy experts (compare Table 6), and groups with very limited agency (influence) and knowledge but who stand to gain from the energy transition, including relatively low-income farmers and fishermen. This should be done in support of and in coalition with national partners of FES-Viet Nam including Vietnamese NGOs under VUSTA, members of the VSEA, the Viet Nam General Confederation of Labour (VGCL), possibly youth organizations, and businesses and business associations that focus on energy efficiency and/or renewable energy.[210]

The decision makers or those with agency (influence) include (compare Table 6): leaders of the Party and Government, including the Prime Minister and ministers and vice-ministers of MOIT, MOF, MPI, MONRE, MARD, Ministry of Construction, Ministry of Transport, and MOLISA; members of the National Assembly and provincial leaders; leaders of energy SoEs and their subsidiaries; leaders of some Development Partners; and leaders of large Vietnamese and foreign private businesses and business associations.

Strategic priorities of campaigns and advocacy should consider the international context of the 2030 Agenda for Sustainable Development,[211] with SDG1 on ending all poverty; SDG5 on gender equality and empowerment of women and girls; SDG 7 on access to affordable, reliable, sustainable and modern energy for all; SDG 8 on inclusive and sustainable economic growth, full and productive employment and decent work for all; and SDG 13 on climate change; as well as the Paris Agreement on climate change and implementation of Viet Nam's NDC.[212]

But actual campaigns and advocacy tend to be most effective if the issue that is campaigned for is quite concrete and specific. A "socially just energy transition" may be the aim, but it is not very specific so it would need to be "unpacked" into focused themes and messages. E.g. the following:

1. Campaign on the advantages of generation of green and clean jobs in renewable energy equipment manufacturing, installation, operation and maintenance; under good occupational health conditions. These are arguments for speeding up transition.
2. Campaign on energy access for the poorest and most vulnerable: migrant workers may not have connections to the power grid in their own names and so pay high unit-cost prices;[213] ethnic minorities in remote areas are maybe not grid-connected or have irregular supply, disadvantaging their children in doing homework; schools, health centres and other services in remote areas may not function well with frequent power cuts; etc.
3. Campaign for policies and regulations that turn energy production into rural area income generation opportunities. There are examples in Germany of rural cooperatives owning small renewable energy systems that are integrated in meadows and farm buildings and that produce excess power that is sold to the national grid, delivering sometimes a significant income to farmers; this could be developed in Viet Nam with certain financing packages. There are already biogas digesters across Viet Nam as well as examples of agricultural waste being used for heat and power generation at an industrial scale; further development of this would increase demand and thus the price of agricultural waste, thereby increasing incomes of farmers and reducing smoke problems from straw burning.

Many things must be done for an effective campaign, including building or strengthening partnerships. Effective campaigning requires a close link with the media, and partnerships with e.g. the Academy of Journalism and Communication and the Viet Nam Journalists Association could also be built or reinforced.[214] FES should also continue as an active member of the Climate Change Working Group of international NGOs in Viet Nam and work closely with other members with an interest in climate change mitigation and green growth, including biogas proponents (notably the Vietnamese Biogas Association and SNV). Links with influential think tanks can be built through applied research that would be an input into campaigns (see section VI.1). Links with national and international business associations are also important for FES to develop (including members of the VBF, EuroCham). FES and some of its partners could actively take part in technical and policy dialogues with officials and Development Partners in the VEPG and its technical working groups, to which some NGOs, research institutes and businesses will also be invited.

Notes

1. See: http://www.evn.com.vn/ ; http://www.vinacomin.vn/ ; http://english.pvn.vn/ ; http://www.petrolimex.com.vn/
2. Notably compliance with SR Viet Nam 2016c. See also: World Bank 2014a; Taussig et al. 2015; Viet Nam News 2017c.
3. UNDP 2014.
4. Kreft et al. 2016.
5. Tran Thuc et al. 2015.
6. Tran Thuc et al. 2016.
7. World Bank 2010.
8. SR Viet Nam 2015a.
9. R Viet Nam 2016b.
10. Several interviewees either said literally what is quoted here or alluded to this, which is supported by written sources such as UNDP 2014.
11. SR Viet Nam 2015b.
12. Neefjes 2016; MONRE 2015.
13. EVN 2016.
14. SR Viet Nam 2017b.
15. But for a recent report see: VIR 2017a.
16. Thanh Nien 2017a; Tuoi Tre 2016a; Saigon Times 2016a; DauTu.online 2016b; VIR 2017c; Reuters 2017.
17. For a map of non-hydro renewable energy projects, see: http://gizenergy.org.vn/en/re-projects-vietnam.
18. SR Viet Nam 2011a gives a FiT of 7.8 US$ cents/kWh for wind power; SR Viet Nam 2014b gives a FiT of 5.8 US$ cents/kWh for biomass.
19. UNDP 2012; UNDP 2014; UNDP 2016; UNDP 2017; Audinet et al. 2016.
20. VBCSD 2014; VBF 2015; EuroCham 2016.
21. VIR 2017c.
22. GIZ 2016d.
23. GIZ 2016c; Power-technology.com 2015; VIR 2016a; CDM 2016.
24. GIZ 2016e; Tuoi Tre 2016b.
25. The Blue Circle 2016; VBN 2016; VnExpress 2017.
26. CSwind.com 2017; Bloomberg 2011; US International Trade Commission 2013; RLS 2016; Viet Nam News 2016; https://solarbk.vn/en/ ; http://redsun-solar.com/; http://www.canadiansolar.com/about.html ; http://www.boviet.com/ ; http://en.jasolar.com/ ; DauTu.online 2016a.
27. UNDP, 2016; Vu Quang Dang 2015; http://solarhub.vn/en/ ; Brohm 2016; https://solarbk.vn/en/ ; VIR 2017c; Tuoi Tre 2016a; Reuters 2017; Saigon Times 2016a.
28. http://nangluongvietnam.vn/news/vn/dien-hat-nhan-nang-luong-tai-tao/dieu-chinh-chu-truong-dau-tu-da-dien-mat-troi-quang-binh.html 13/12/2016.

29. http://nangluongvietnam.vn/news/vn/dien-hat-nhan-nang-luong-tai-tao/genco3-dau-tu-2-du-an-dien-mat-troi-tai-ninh-thuan.html 27/04/2017.
30. http://nangluongvietnam.vn/news/vn/dien-hat-nhan-nang-luong-tai-tao/khoi-dong-du-an-dien-mat-troi-2-ty-usd-tai-ninh-thuan.html 13/03/2017
31. SR Viet Nam 2011b.
32. GreenID 2015; GreenID 2016.
33. VSEA 2016. The VSEA website is: https://www.vsea.info/.
34. GreenID 2016; RLS 2016
35. Nguyen Van Vy 2016.
36. ADB 2015b.
37. Enerdata 2017.
38. SR Viet Nam 2016a.
39. SR Viet Nam 2015b.
40. GreenID 2016.
41. ADB 2015a; AWS Truepower 2011; AECID-MOIT 2014; GreenID 2016.
42. IES & MKE 2016.
43. AECID-MOIT 2014.
44. http://globalsolaratlas.info/?c=16.088042,91.010742,4.
45. Audinet et al. 2016.
46. EVN 2017.
47. Le Anh Tuan 2016.
48. SR Viet Nam 2004; SR Viet Nam 2012c; SR Viet Nam 2013a; SR Viet Nam 2017a.
49. ADB 2015.
50. EVN 2017.
51. World Bank 2016b.
52. SR Viet Nam 1993/2000/2008; SR Viet Nam 2004; SR Viet Nam 2008; SR Viet Nam 2010.
53. GreenID 2016.
54. SR Viet Nam 2014; SR Viet Nam 2010b.
55. Pham Lan Huong 2014.
56. SR Viet Nam 2007.
57. SR Viet Nam 2006; SR Viet Nam 2012b. For initiatives and success stories see the website of the VNEEP: http://tietkiemnangluong.com.vn/.
58. SR Viet Nam 2012a.
59. UNDP 2014.
60. UNDP 2016; UNDP 2017.
61. SR Viet Nam 2014a.

62. The projects are subject to fund availability, and because of public debt concerns the Government is restricting certain investments.
63. SR Viet Nam 2014a.
64. SR Viet Nam 2015b.
65. SR Viet Nam 2011b; SR Viet Nam 2016a. There are differences in (renewable) electricity targets in these policies, and in the forthcoming Renewable Energy Development Action Plan the targets from PDP7-revised are expected to be the basis for actions.
66. SR Viet Nam 2016a.
67. MOIT 2008.
68. MOIT 2016.
69. GIZ 2016b.
70. SR Viet Nam 2011a. All FiTs are set in US$ and the price in VND is adjusted according to exchange rate fluctuations over the lifetime of the renewable energy investment project.
71. MOF 2012.
72. The LCOE is the net present value of the cost of a unit of energy (e.g. 1 kWh of electricity) over the lifetime of a power plant, considering investment costs and a lifetime of fuel supply, operation and maintenance.
73. SR Viet Nam 2014a; SR Viet Nam 2014b.
74. Support policies with these FiTs were issued at different times, using different US$-VND exchange rates.
75. SR Viet Nam 2015a.
76. MONRE 2015; Neefjes 2016.
77. The BAU in the (I)NDC excludes PDP7-revised and the Renewable Energy Development Strategy, which were approved after its formulation. These policies would reduce the BAU for 2020 and 2030, which must be considered in a review and update of the NDC as is mandated under the Paris Agreement prior to 2023.
78. Energy sector emissions are from the combustion of fossil fuels in power production, industry, transport, etc, as well as fugitive emissions from fossil fuel production (MONRE 2015).
79. SR Viet Nam 2016b.
80. Neefjes 2016.
81. EuroCham 2016.
82. This is a key argument in Trương Duy Nghĩa et al. (2017), a series of articles on "why must Viet Nam develop coal-power?" for the Viet Nam Energy Association (VEA): http://nangluongvietnam.vn/news/vn/trang-chu.
83. SourceWatch 2016; VSEA & NCDs-VN 2016.
84. ADB 2016a.
85. See also: World Bank 2011.
86. SR Viet Nam 2013b.
87. Nguyen K.Q. 2006.
88. Baulch et al. 2015.
89. Nguyen Thien Thanh 2005.

90. La Hai Anh et al. 2013; La Hai Anh et al. 2017; UNDP 2017.
91. Tu Chi Nguyen 2013.
92. UNDP 2012.
93. http://www.globalpetrolprices.com/gasoline_prices/ (accessed on 27 March 2017).
94. UNDP 2014.
95. UNDP 2012; UNDP 2016 (estimates of subsidies are based on International Energy Agency (IEA) data).
96. VIR 2016d.
97. Worldatlas.com 2017.
98. UNDP 2014.
99. UNDP 2012; UNDP 2014; UNDP 2016; UNDP 2017.
100. SR Viet Nam 2012a.
101. E.g. VIR 2016c.
102. http://www.tinmoi.vn/lam-ro-viec-evn-thua-lo-hon-10-nghin-ty-dong-01648751.html.
103. EVN 2017: these figures were converted from VND to US$ with an exchange rate of 1 US$ = 22,730 VND.
104. Viet Nam News 2017a.
105. World Bank 2016a. Assuming annual inflation of about 6% this is equal to a 15% constant price increase, i.e. similar to what Willenbockel and Ho Cong Hoa (2011) and UNDP (2012) assumed – see below.
106. UNDP 2012; Willenbockel and Ho Cong Hoa 2011.
107. IES & MKE 2016; see also Neefjes 2016.
108. Romm 2017.
109. Audinet et al. 2016.
110. UNDP 2014; based on Dang Thi Thu Hoai and Tran Toan Thang 2013.
111. Nguyen Manh Hai et al. 2015.
112. Garg et al. 2015.
113. EuroCham 2016.
114. Word Bank and CIEM 2012.
115. UNDP 2012; Willenbockel and Ho Cong Hoa 2011; La Hai Anh et al., 2013; UNDP 2014; UNDP 2017; La Hai Anh et al. 2017; Nguyen Thi Thu Phuong 2017.
116. i.e. the differences between tariffs for the first units of electricity per month and tariffs for high levels of consumption were reduced.
117. This is estimated from the aggregated employment in related sectors: mining and quarrying was 237,000; electricity, gas, stream and air conditioning supply was 146,000 in 2015.
118. IES & MKE 2016.
119. IRENA 2016.
120. RLS 2016.
121. Vu Dinh Ton et al. 2013; Ashden Awards 2010.

122. https://energypedia.info/wiki/Biogas_Technology_in_Vietnam and http://digitalcollections.sit.edu/cgi/viewcontent.cgi?article=1322&context=isp_collection.
123. Trương Duy Nghĩa et al. 2017.
124. GreenID 2016; RSL 2016.
125. UN-Viet Nam and Oxfam Viet Nam 2009; Neefjes et al. 2016.
126. Copsey et al. 2013.
127. UNDP 2016.
128. This is made of particles smaller than 2.5 microns, which are harder to filter and penetrate deep in the lungs.
129. The PM2.5 Air Quality Index (AQI) according to the standards of the US EPA (Environmental Protection Agency) on http://aqicn.org/city/vietnam/hanoi/ can also be accessed through mobile phone apps.
130. See: http://www.hanoi.gov.vn/quantracmoitruong and http://moitruongthudo.vn/ which follows the Vietnamese AQI as per Vietnamese environmental regulation QCVN 05:2009/BTNMT includes SO2, CO, NOx, O3, PM10, and total suspended particles (TSP).
131. Dang Thi Thu Hoai and Tran Toan Thang 2013; Garg et al. 2015; Nguyen Manh Hai et al. 2015; EuroCham 2016.
132. Nguyen Thi Thu Phuong et al. 2013; Nguyen Thi Thu Phuong 2017.
133. CIEM 2013; UNDP 2014; Long Thang Nguyen 2015; Carbon Trust 2016; EuroCham 2016; IOE 2016; Vu Chi Mai 2016; Andreatta 2016.
134. Andreatta 2016.
135. SR Viet Nam 2015b.
136. SR Viet Nam, 2017b.
137. Neefjes 2017.
138. Baulch et al. 2015.
139. Based on an interview with Vietnamese companies in this sector.
140. Saigon online 2016.
141. SR Viet Nam 2016a.
142. SR Viet Nam 2014b.
143. See e.g. http://blogs.duanemorris.com/vietnam/2015/01/30/lawyer-in-vietnam-oliver-massmann-renewable-energy/.
144. This is the subject of Document number 05/TTr-KCNC, of March 1st, 2017 of the Management Board of the High-Tech Park of Ho Chi Minh City submitted to the People's Committee of Ho Chi Minh City.
145. Vietnam.net 2016.
146. Pumped storage is when a hydro-power plant uses excess electricity, for example during times of low demand or high supply, to pump water from downstream back up to the reservoir, effectively storing the energy as gravitational potential.
147. UNDP 2014; Garg et al. 2015; IISD-GSI 2015.
148. UNDP 2014; UNDP 2017.
149. UNDP 2016; Neefjes 2017.
150. See e.g.: UNDP 2016; Brohm 2016.

151. GIZ 2016a, 3.
152. See e.g.: Vu Dinh Ton et al. 2016.
153. GreenID 2016; RLS 2016.
154. Koplitz et al. 2015; UNDP 2016.
155. UNDP 2016.
156. Audinet et al. 2016; Nguyen Manh Hai et al. 2015.
157. Viet Nam News 2017d.
158. VET 2017.
159. VBF 2016; EuroCham 2017, 29-34.
160. See e.g.: UNDP 2016; Audinet et al. 2016; Bogach et al. 2002; GIZ 2015.
161. GreenID 2016; IES & MKE 2016; RLS 2016; Wörlen 2016.
162. GreenID 2015.
163. SR Viet Nam 2015b.
164. Such views were voiced in e.g. technical workshops on research drafts that supported the production of: UNDP 2014; UNDP 2017.
165. IES & MKE 2016.
166. EuroCham 2016.
167. UNDP 2016.
168. GreenID 2016.
169. VSEA & NCDs-VN 2016.
170. See: Communist Party Resolution nr 24-NQ/TW of 3 June 2013, on "active response to climate change, strengthening natural resources management and environmental protection".
171. Thanh Nien 2017b.
172. Audinet et al. 2016.
173. UNDP 2014; Audinet et al. 2016.
174. UNGA 2015; SR Viet Nam 2016b.
175. CVF 2016.
176. See e.g. IES & MKE 2016.
177. Audinet et al. 2016.
178. EuroCham 2017, 29-34.
179. See e.g.: RLS 2016; GreenID 2016.
180. UNDP 2014.
181. Viet Nam News 2017c.
182. UNDP 2014.
183. UNDP 2014.

184. VIR 2017.
185. An Ha Truong et al. 2016.
186. IES & MKE 2016.
187. UNDP 2012; UNDP 2014; UNDP 2017.
188. UNDP 2014; VBF 2015; UNDP 2016; World Bank 2016a.
189. SR Viet Nam 2015b.
190. UNDP 2017.
191. Dang Thi Thu Hoai and Tran Toan Thang 2013; Nguyen Manh Hai et al. 2015.
192. IES & MKE 2016.
193. Dang Thi Thu Hoai and Tran Toan Thang, 2013; Nguyen Manh Hai et al. 2015.
194. See e.g.: An Ha Truong et al. 2016.
195. See e.g.: UNDP 2016; Audinet et al. 2016.
196. Audinet et al. 2016.
197. UNGA 2015.
198. The VEA website is partially in English: http://nangluongvietnam.vn/news/en/home.
199. http://www.epu.edu.vn/en/Default.aspx.
200. http://www.oisp.bku.edu.vn/en/.
201. https://en.hust.edu.vn/.
202. http://www.ievn.com.vn/ and https://www.vpi.pvn.vn/vn/Home.aspx.
203. https://www.vsea.info/.
204. http://www.vusta.vn/en/ .
205. http://rtccd.org.vn/en/vietnam-non-communicable-disease-prevention-alliance-ncds-vn/ CCWG 2016; http://www.ngocentre.org.vn/ccwg.
206. GreenID 2013.
207. Quoted from the Terms of Reference of the VEPG.
208. http://www.vbf.org.vn.
209. VBF 2015; VBF 2016.
210. E.g. the Binh Thuan Wind Association and the Association of Energy Conservation and Efficiency.
211. UNGA 2015.
212. SR Viet Nam 2016b.
213. La Hai Anh et al. 2013.
214. http://vja.org.vn/vi/.

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Imprint

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